AIR DISPERSION MODELING ASSESSMENT OF AIR TOXIC EMISSIONS FROM BNSF SAN BERNARDINO RAIL YARD

Submitted to:
California Air Resources Board

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ACRONYMS

ARB	Air Resources Board
BAAQMD	Bay Area Air Quality Management District
BNSF	BNSF Railway Company
BPIP-PRIME	Building Profile Input Program – Plume Rise Model Enhancement
CalEPA	California Environmental Protection Agency
CalOSHA	California Occupational Safety and Health Administration
CARDS	Comprehensive Aerological Reference Dataset
DPM	Diesel particulate matter
ENVIRON	ENVIRON International Corporation
GE	General Electric
GIS	Geographic Information Systems
HD	Heavy-duty
HRA	Health Risk Assessment
I	Interstate
ISC	Industrial Source Complex
IGRA	Integrated Global Radiosonde Archive
LD	Light-duty
MATES	Multiple Air Toxics Exposure Study
MOU	Memorandum of Understanding
MTBE	Methyl t-butyl ether
NAS	Naval Air Station
NCDC	National Climactic Data Center
NLCD	National Land Cover Data
NRC	National Research Council
NWS	National Weather Service
OEHHA	Office of Environmental Health Hazard Assessment
PM	Particulate matter
PMI	Point of maximum impact
POLA	Port of Los Angeles
POLB	Port of Long Beach
RAAC	Risk Assessment Advisory Committee
SCAQMD	South Coast Air Quality Management District
SCRAM	Support Center for Regulatory Atmospheric Modeling
TAC	Toxic Air Contaminant
ULSD	Ultra low sulfur diesel

UPRR	Union Pacific Railroad Company
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VMT	Vehicle miles traveled
WBAN	Weather Bureau Army Navy

ABREVIATIONS

%	percent
AERMAP	AERMOD Terrain Processor
AERMET	AERMOD Meteorological Preprocessor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
COOP	Cooperative Station (NWS)
kg	kilogram
km	Kilometer
L	liter
m^3	cubic meter
µg	microgram

1.0 INTRODUCTION

In June 2005, BNSF Railway Company (BNSF) and Union Pacific Railroad Company (UPRR) entered into a mutual agreement (ARB Railroad Statewide Agreement, 2005b or the "Agreement") with the California Air Resources Board (ARB) to reduce particulate emissions from their respective rail yards that are owned and operated within the State of California. Under provisions of the Agreement, ARB staff will be performing Health Risk Assessments (HRAs) at 17 rail yards ("Designated Rail Yards") within California. The HRAs will consider emissions of toxic air contaminants (TACs) from emission sources at each Designated Rail Yard including resident and transient locomotives, on- and off-road equipment, and stationary equipment.

Generally, an HRA consists of three major parts: (1) an air emissions inventory for TAC emission sources, (2) air dispersion modeling to evaluate off-site airborne concentrations due to TAC emissions from these sources, and (3) the assessment of risks associated with these predicted airborne concentrations. The UPRR and BNSF are required to complete the first two parts of the risk assessment process under the Agreement. Under the MOU, ARB will conduct the assessment of risks part of the HRA process using the results of air dispersion exposure analyses conducted for each Designated Rail Yard. As noted in the MOU, specific objectives of these risk assessments include developing a basis for risk mitigation and risk communication, including developing information to place the estimated risks in appropriate context. To aid in developing information for risk communication, ARB will also be conducting health risk assessments for other significant sources of TACs within the vicinity of each Designated Rail Yard.

BNSF has retained ENVIRON International Corporation (ENVIRON) to assist it with the development of TAC emissions inventories and in conducting the air dispersion modeling for each of their Designated Rail Yards. Under the current draft Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities (the "draft Guidelines", (ARB 2006a)), emission inventories and air dispersion modeling results for the following BNSF Designated Rail Yards were submitted in 2006: Commerce/Eastern Intermodal, Commerce/Mechanical, Los Angeles Intermodal (Hobart), Richmond, Stockton, and Watson/Wilmington (the "2006 BNSF Designated Rail Yards"). Emission inventories and air dispersion modeling results for the following BNSF Designated Rail Yards will be submitted in 2007: San Bernardino, Barstow, and San Diego (the "2007 BNSF Designated Rail Yards"). This report presents the methods and results of the air dispersion modeling analysis conducted to evaluate TAC emissions from operations at the San Bernardino Rail Yard located in San Bernardino, California ("San Bernardino").

1.1 Objectives

The purpose of this report is to summarize ENVIRON's methods used to conduct the air dispersion exposure assessment of TAC emissions from the BNSF San Bernardino Yard and to provide the results of this analysis to ARB for their completion of the HRA for this rail yard. As discussed in the draft Guidelines (ARB 2006a), the air dispersion modeling exposure assessment requires the selection of the dispersion model, the data that will be used in the dispersion model (pollutants to be modeled with appropriate averaging times, source characterization, building downwash, terrain, meteorology) and the identification of receptors whose potential exposure will be considered in ARB's HRA. ENVIRON previously provided to ARB a report that described ENVIRON's model selection, meteorological data selection, and meteorological data processing methodologies for all the 2007 BNSF Designated Rail Yards (ENVIRON 2007a). ARB approved these aspects of the air dispersion modeling analysis on August 31, 2007.[1] The remainder of this introduction section summarizes ENVIRON's selection of the air dispersion model to provide the modeling context for the methods discussed in the remainder of this report.

1.2 Methodologies

As discussed in the draft Guidelines, "air dispersion modeling uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source" (ARB 2006a). The Agreement currently requires that air dispersion modeling be performed to estimate airborne concentrations from the dispersion of TAC and particulate matter emissions from relevant sources at each Designated Rail Yard. The emissions of diesel particulate matter (DPM) are separated from other particulate related TAC emission data in the model input and output (ARB 2006a). Air dispersion modeling requires the selection of an appropriate dispersion model and input data based on regulatory guidance, common industry standards/practice, and/or professional judgment. In general, ENVIRON performed air dispersion modeling for the BNSF Designated Rail Yards consistent with previous studies and/or guidance documents prepared by ARB (ARB 2004, 2005a, 2005c, 2006a) and the United States Environmental Protection Agency (USEPA 2000, 2004a, 2004b, 2005a, 2005b).

ENVIRON used the latest American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD version 07026) to estimate airborne concentrations resulting from

[1] Personal communication, H. Holmes of ARB by e-mail to D. Daugherty of ENVIRON on August 31, 2007.

TAC emissions from the BNSF San Bernardino Yard. It should be noted that this version of AERMOD (i.e., version 07026) is an updated version to the version of the model used for the 2006 BNSF Designated Yards (i.e., version 04300). AERMOD model was developed as a replacement for USEPA's Industrial Source Complex (ISC) air dispersion model to improve the accuracy of air dispersion model results for routine regulatory applications and to incorporate the progress in scientific knowledge of atmospheric turbulence and dispersion. Both models are near-field, steady-state Gaussian plume models, and use site-representative hourly surface and twice-daily upper air meteorological data to simulate the effects of dispersion of emissions from industrial-type releases (e.g., point, area, and volume) for distances of up to 50 kilometers (USEPA 2005b).

For the past 20 years, refined near-field air dispersion modeling has typically been conducted using USEPA's Industrial Source Complex (ISC) model. However, on November 9, 2005, the USEPA promulgated final revisions to the federal Guideline on Air Quality Models (USEPA 2005a). These revisions recommend that AERMOD, including the PRIME building downwash algorithms, be used for dispersion modeling evaluations of criteria air pollutant and toxic air pollutant emissions from typical industrial facilities. A one-year transition period occurred from November 9, 2005 to November 9, 2006. Following this transition period, all refined, near-field air dispersion modeling following EPA guidance is required to use AERMOD. AERMOD provides better characterization of plume dispersion than does ISC, according to USEPA (USEPA 2003). AERMOD also is the model recommended by ARB in the draft Guidelines (ARB 2006a).

1.3 Report Organization

This report is divided into six sections as follows:

Section 1.0 - Introduction: describes the purpose and scope of this report and outlines the report organization.

Section 2.0 - Site Description: provides a brief description of the San Bernardino Facility and its operations.

Section 3.0 - Emission Inventory Summary: summarizes the TAC emission inventory results that were previously submitted to ARB under a separate report.

Section 4.0 - Air Dispersion Modeling: describes the air dispersion modeling methods used to estimate air chemical concentrations.

Section 5.0 -Uncertainties: summarizes some of the uncertainties resulting from various assumptions used in the air dispersion evaluation as well as from those used in the emission inventory development.

Section 6.0 – References: includes all references cited in this report.

The appendices include supporting information as follows:

Appendix A: provides the tables of hourly, daily, and seasonal temporal information for source activities

Appendix B: provides the electronic SCREEN3 input and output files for plume rise adjustments for locomotive movement activities

Appendix C: provides the electronic AERMOD-ready meteorological data files and raw surface and upper air meteorological data files

Appendix D: provides the electronic building downwash input and output files

Appendix E: provides the electronic digital elevation model (DEM) files

Appendix F: provides the electronic shapefiles containing census data for the San Bernardino area

Appendix G: discusses the sensitivity analysis used to determine the spacing and extents of the receptor grids

Appendix I: provides the electronic input and output files for AERMOD

Appendix I: provides the air concentration results in a Microsoft Access database, the methodology for the calculation of air concentrations, and the electronic database files and queries used to perform the calculations

2.0 SITE HISTORY

The San Bernardino site description incorporated in this evaluation is based primarily on information provided by BNSF and its contractors' staff. The following information is included to facilitate understanding of this site's operations as evaluated by this work.

2.1 Site Setting and Description

San Bernardino is located at 1535 West 4th Street in San Bernardino, California, in downtown San Bernardino. As shown in Figure 2-1, BNSF San Bernardino is located in a commercial and manufacturing area with several residential areas located within three kilometers. BNSF San Bernardino is bordered by West 4th Street and West 5th Street to the north, the Riverside Freeway (i.e., Interstate 215) and commercial/industrial properties to the east, West 3rd Street and Adjacent Main Line to the South, and residential properties to the west. San Bernardino is also located within five kilometers of three other major roadways, including: Interstate 210 (I-210) to the north, Highway 30 to the north and east, and Interstate 10 (I-10) to the south. Figure 2-2 depicts available land use data from the United States Geological Survey's (USGS's) National Land Cover Dataset (USGS 2006) within 20 kilometers (km) of San Bernardino, as required by the draft Guidelines (ARB 2006a). Table 2-1 summarizes the percentage of each land use category within this 20-km radius.

The San Bernardino Yard is split into two distinct sections - an east-west aligned intermodal rail yard ("A" yard) and a roughly north-south aligned locomotive classification yard ("B" yard), as shown in Figure 2-3. The Facility also includes administration and equipment maintenance buildings and three satellite areas used for container storage located at the northwest end of the Facility. The adjacent main line located along the southern edge of the east portion of the "A" yard is used for passenger rail (both Amtrak and Metrolink) and freight services. ENVIRON included this segment of the adjacent main line in the air dispersion modeling analysis as per the draft Guidelines.

2.2 Facility Operations

Activities at San Bernardino include locomotive refueling and switching, line-haul and passenger locomotives, cargo handling equipment, track maintenance equipment, on-road fleet vehicles, on-road container trucks, transportation refrigeration units (TRUs), and permitted stationary source activities. The approximate locations of these activities at the Facility are shown in Figures 2-4 through 2-16.

The Facility emissions activities can generally be divided into two operational areas: the "A" yard (i.e., the intermodal rail yard) consisting of a locomotive refueling area, a locomotive classification yard, and intermodal areas; and the "B" yard (i.e., the automotive yard) consisting of a locomotive classification yard. The main purpose of the "A" yard is to build and configure trains. In order to build and configure trains, containers or truck chassis are hauled into the yard, temporarily stored and then loaded onto a rail car. The intermodal cargo is carried in either containers or trailers, both of which may be loaded onto flatbed railcars. The railcars are moved within the yard by switching locomotives. Containers and trailers are brought into the "A" yard from surrounding industrial areas by on-road container trucks. The transfer of containers within the "A" yard as well as the loading of the containers and trailers onto trains uses off-road heavy equipment (yard tractors, lift machines, gantry cranes). Loading activity in the "B" yard is currently at a very low level. Furthermore, the predominant unloading of auto rail cars utilizes the power of the self propelled gasoline vehicles and thus does not contribute to the particulate emissions. A limited number of trains enter the Facility and receive a change of operating crew without being reconfigured or receiving service. In addition to BNSF operations there are some limited non-BNSF freight trains as well as passenger trains that use rail lines that run through or adjacent to both the "A" and "B" yards.

The emission activities, described in further detail in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b), occurring in these operational areas are outlined below:

Facility Operational Areas and Activities

"A" Yard (Intermodal Rail Yard)

Locomotive Refueling Area

A. Locomotive Refueling

Classification Yard

C. Crew Change
D. Switching
E. Arriving-Departing Line-Haul
F. Passing Line-Haul
G. Passenger Locomotives
K1a. Boxcar/Freight TRUs
K2. Track Maintenance

lntermodal Areas

H. Cargo Handling Equipment

I. On-Road Container Trucks

J. On-Road Fleet Vehicles

K1b. Container/Trailer TRUs

L. Permitted Stationary Sources

"B" Yard (Automotive Yard)

Classification Yard

C. Crew Change

D. Switching

E. Arriving-Departing Line-Haul

F. Passing-Line Haul

G. Passenger Locomotives

K1a. Boxcar/Freight TRUs

K2. Track Maintenance Equipment

As discussed above the "A" yard is oriented in an east-west direction and consists of a locomotive refueling area, a locomotive classification yard, and intermodal areas. The locomotive refueling area is located in the western portion of the "A" yard to the south of the fly-over tracks as shown in Figure 2-4. Locomotive idling occurs during the refueling process, which occurs directly from trucks and only in the locomotive refueling area. Locomotives enter and exit the refueling area from the main line as indicated in Figure 2-4.

The classification yard is located in the south portion of the "A" yard east of the East Channel of Lytle Creek and is bisected by Mt. Vernon Avenue, dividing the yard into east and west sections. Each section contains approximately eight to ten rail lines that run in parallel and converge at the West 5th Street overpass (in the east section) and at the fly-over tracks (in the west section). Activities in the classification yard include locomotive switching, arriving-departing and passing locomotives, locomotive crew change, cargo handling equipment (i.e., cranes and hostlers), boxcar/freight TRUs, and track maintenance equipment. Locomotive switching, boxcar/freight TRU, and track maintenance equipment activities may occur anywhere in the classification yard, as shown in Figures 2-4, 2-5, and 2-6, respectively. Arriving-departing locomotives enter and depart the "A" yard on the main line and are routed to tracks within the classification yard as indicated in Figure 2-7. Locomotive crew change activities (i.e., locomotives that only receive a change of crew) occur on the same rail lines as arriving-departing locomotive activities. Passing line-haul locomotives travel only on the main line, as indicated in Figure 2-8. Crane operations may occur anywhere along the parallel rail lines to the east and west of Mt. Vernon Avenue, as shown in Figure 2-9. Hostler operations that occur within the classification yard are limited to the northern section of the classification yard, as shown in Figure 2-9. Passenger locomotive activities (i.e., Amtrak and Metrolink) also occur on a set of tracks adjacent to the main line that runs along the southern boundary of the "A" yard. Metrolink trains enter the Facility from the west end of the "A" yard and use the fly-over tracks to reach the San Bernardino Metrolink/Amtrak station, located along the southern boundary of the "A" Yard between Mt. Vernon Avenue and North K Street, as indicated in Figure 2-10. Amtrak trains diverge from the main line just to the west of Mt. Vernon Avenue, but unlike the Metrolink trains, also travel east/north on the main line from the San Bernardino Metrolink/Amtrak station, as shown in Figure 2-10.

The "A" yard contains two intermodal areas - the East and West Intermodal Areas, as shown in Figure 2-2. The majority of the intermodal activities occur in the East Intermodal Area, located in the northeast portion of the "A" yard. The West Intermodal Area is located in the western part of the "A" yard north of the fly-over tracks. Both intermodal areas include cargo handling equipment (i.e., lift machines and hostlers), on-road container truck, on-road fleet vehicle, and container/trailer TRU activities. Cargo handling equipment (i.e., lift machines and hostlers) and on-road container trucks may operate anywhere in the East and West Intermodal Areas, as shown in Figures 2-9 and 2-11. On-road container trucks and refueling trucks enter and exit the facility on from the main ingress/egress on West 4th Street. The locations of truck idling activity at the entrance and exit gates are indicated in Figures 2-11 and 2-12. On-road container trucks travel east and west along the roadway paralleling West 4th Street to and from either the East or West Intermodal Areas, as shown in Figure 2-11. On-road fueling trucks travel along similar entrance and exit paths as the on-road container trucks, but operate over a small portion of the East Intermodal Area (i.e., near the gasoline dispensing and storage facility and Eagle Repair Building), as indicated in Figure 2-12. On-road fleet operations in the "A" yard consist of BNSF, Eagle (intermodal contractor), and Progressive (mechanical maintenance contractor) fleets. BNSF fleet vehicle operations are limited to areas in the vicinity of the BNSF Administration Office and equipment storage buildings, as shown in Figure 2-13. Eagle fleet vehicles enter and exit the Facility at the main ingress/egress, travel along the roadway parallel to West 4th Street, and may operate anywhere in the East or West Intermodal Areas, as shown in Figure 2-13. The Progressive fleet vehicles also enter and exit the Facility through the main ingress/egress and may operate anywhere in the classification yard or in the rail car maintenance area to the southwest of the locomotive refueling area as indicated in Figure 2-14.

Two stationary sources are located in the "A" Yard, including a gasoline dispensing and storage facility and an emergency generator. The gasoline dispensing and storage facility is located in the center of the portion of the "A" yard, near the intersection of West 4th Street and Mt. Vernon Avenue as indicated in Figure 2-15. The emergency generator is located in western portion of the "A" yard near the southwest corner of the BNSF Administration Building as shown in Figure 2-15.

The "B" yard is generally oriented in a north-south direction and consists of a locomotive classification yard. Emission activities at the "B" yard include locomotive switching, arriving-departing and passing line-haul trains, passenger locomotives, boxcar/freight TRUs, and track maintenance equipment. Locomotive switching, track maintenance, and boxcar/freight TRU activities may occur anywhere in the "B" yard, as shown in Figures 2-4, 2-6, and 2-16, respectively. Arriving-departing locomotives enter and depart the "B" yard on the main line, which passes through the center of the "B" Yard, and are routed to tracks within the classification yard as indicated in Figure 2-7. Similar to the classification yard, locomotive crew change activities at the "B" Yard occur on the same rail lines as arriving-departing locomotive activities. Passing line-haul locomotives travel only on the main line, as indicated in Figure 2-8. Passenger locomotive activities (i.e., Amtrak) occur on a set of tracks that run adjacent to the east boundary of the "B" yard, as shown in Figure 2-10.

3.0 EMISSION INVENTORY SUMMARY

ENVIRON estimated emissions for BNSF San Bernardino Yard activities and provided this to ARB previously (ENVIRON 2007b). The methodology used to calculate the DPM and gasoline TAC emission factors were described in this previous submission to ARB. Detailed calculation methodologies and the resulting emission factors are also included. The remainder of this section provides a brief summary of the San Bernardino activities for which TAC emissions were estimated.

3.1 Locomotive DPM Emissions

ENVIRON described San Bernardino locomotive operations by dividing the emissions activities into five emissions categories:

A. Basic Services
C. Crew Change
D. Switching
E. Arriving and Departing Trains
F. Adjacent Freight Movements
G. Passenger Rail Operations

Category designations (i.e., A, C, D, E, F, and G) for each locomotive activity were assigned in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b).

From data provided by BNSF and through discussions with BNSF operations staff, ENVIRON determined the overall activity of locomotive operations. The locomotive operations data included the number of engines and the typical time in notch setting for those engines active at the facility. ENVIRON inferred locomotive movements and time in engine notch settings based on information provided by BNSF. ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b) provides a detailed description of the information and estimates used to define operations and resulting emissions within activity categories A, C, D, E, F, and G. Temporal emission profiles were developed for locomotive activities based on operating schedules provided by BNSF. Variable hourly emission factors were applied in the air dispersion modeling to approximate the temporal variations in emissions from locomotive activities, as discussed in Section 4.3. These temporal emission factors are presented in electronic tables in Appendix A.

The passenger locomotive activities (including both Amtrak and Metrolink activities, designated as activity category G) on the main line and fly-over tracks could be considered as separate sources from the Facility operational areas as these activities operate by and large independent of the Facility. ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b) contains the details of the methods used to estimate emissions from these activity categories. Temporal emission profiles were developed for passenger rail activities based on hourly schedule information for Amtrak and Metrolink activities. Variable hourly, daily, and seasonal emission factors were applied in the air dispersion modeling, as discussed in Section 4.3, to approximate the temporal variations in emissions for passenger locomotive activities. These temporal emission factors are presented in electronic tables in Appendix A.

3.2 DPM Emissions from Cargo Iandling Equipment

Cargo handling equipment (designated as activity category H) consisted of equipment that was used to handle intermodal freight at the San Bernardino Yard and included lift machines, cranes, and yard hostlers. DPM emissions due to cargo handling equipment activities were estimated using the emission factors determined using the equipment population list and default activity data from the draft EMFAC2005 model provided by ARB (2006c). Additional details regarding the emission calculation methodology are discussed in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b).

3.3 DPM Emissions from On-Road Container and Refueling Trucks

On-road container and refueling trucks (designated as activity category I) included tractor-trailer trucks that receive or deliver containers to the intermodal areas at the Facility and refueling trucks that deliver fuel to the gasoline storage and dispensing facility and locomotives in the locomotive refueling area. DPM emissions due to on-road container truck travel at San Bernardino were estimated using emission factors from the draft EMFAC2005 model provided by ARB (2006c) and an average on-site travel distance. On-road container and refueling truck counts at the facility entrance and exit gates, entrance and exit queuing time (used in the calculation of idling emissions at the entrance and exit gates), and average speed and distance on site were determined from a sample chase truck study at the San Bernardino Yard. Additional details regarding the emission calculation methodologies are discussed in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b).

3.4 DPM and Gasoline TAC Emissions from On-Road Fleet Vehicles

On-road fleet vehicles (designated as activity category J) included both BNSF-owned and contractor-owned (i.e., Eagle International and Progressive Rail Service) employee vehicles and road-legal vehicles (i.e., passenger vehicles and small trucks) used for both on-site and off-site travel. DPM and gasoline TAC emissions due to BNSF and non-BNSF on-road fleet vehicle activities were estimated using the emission factors from the draft EMFAC2005 model provided by ARB (2006c) and an average on-site travel distance. ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b) presents additional details regarding the methods used to estimate emissions from these vehicle activities.

3.5 DPM and Gasoline TAC Emissions from Off-Road Equipment

ENVIRON categorized off-road equipment at the Facility into two main types of equipment: TRUs and track maintenance equipment (designated as activity category K). TRUs are used to regulate temperatures during the transport of products with temperature requirements. For BNSF operations at San Bernardino, temperatures are regulated by TRUs in boxcars, freight cars, shipping containers, and trailers when the material being shipped requires such temperature regulation. TRU emissions were estimated using the draft version of the OFFROAD model provided by ARB (2006c). TRU yearly activity was estimated using the time onsite by TRU configuration (either railcar/freight car or shipping container/trailer) and mode of transport. This activity data was used along with ARB default age, horsepower, and load factor input estimates in the OFFROAD model to estimate TRU emissions. An additional factor of 0.6 was used to account for the only temporary use of TRU units. All TRUs are assumed to use diesel fuel. Additional details regarding the emission calculation methodologies are discussed in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b).

Track maintenance equipment included equipment used to service tracks and included a variety of large and small engines and equipment. BNSF California track maintenance equipment can be used on any or all tracks within California to maintain the network. Therefore, DPM and gasoline TAC emissions for a given facility were estimated by apportioning the sum of emissions from all track maintenance equipment in California by site using the relative track mileage (including all tracks, main line and other tracks) at the site to the California total track mileage. Total exhaust emissions from track maintenance equipment were estimated using the draft version of the OFFROAD model (ARB 2006c). Additional details regarding the emission calculation methodologies are discussed in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b).

3.6 DPM and Gasoline TAC Emissions from Stationary Sources

Stationary sources at the Facility included a gasoline dispensing and storage facility and one emergency generator (designated as activity category L).

TAC emissions from the gasoline dispensing and storage facility were estimated based upon the emissions methodology in the South Coast Air Quality Management District (SCAQMD) permit application (Application #N5916) for this emissions source. The SCAQMD methodology contained emission factors and followed guidance from the Gasoline Service Station Industry-Wide Risk Assessment Guidelines (CAPCOA 1997) prepared by the Toxics Committee of the California Air Pollution Control Officers Association (CAPCOA). This methodology accounted for TAC emissions from filling/working, dispensing, spillage, and breathing. Additional details regarding the emission calculation methodologies are discussed in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b).

DPM emissions from the emergency generator were estimated based on maximum permitted operating hours (Permit #R-D21147), maximum state- or district-permitted PM certification levels, and engine horsepower. As the actual hours of operation and engine PM certification levels were not available from BNSF personnel, Facility records, engine manufacturer information, or district permits or permit applications, ENVIRON's emissions calculations resulted in conservative estimates (i.e., over-predictions) of emissions for the emergency generator. In addition, source parameter information was not available for the emergency generator from BNSF personnel, Facility records, the engine manufacturers, or district permit applications and permits. Based on the conservative emission estimates, the emergency generator accounted for only 0.4% of the total DPM emissions from the Facility. Due to the lack of source parameter information and the relatively low levels of emissions from this source, the emergency generator was not included in the air dispersion modeling.

3.7 Emission Estimates Summary

Tables 3-1a and 3-1b summarize the total annual emissions, operating hours, and the emission rate (in grams per second or grams per square meter per second) for each emission source by activity subcategory for DPM and gasoline emission sources, respectively. ENVIRON performed the air dispersion modeling to estimate period-average DPM and gasoline concentrations using χ/Q emission rates (i.e., one gram per second per source for point and volume sources and one gram per second divided by the total surface area of the source group for each area source), resulting in period-average dispersion factors. Tables 3-1a and 3-1b include the emission rates (in grams per second) applied to the period-average dispersion factors from the air dispersion model to calculate period-average air concentrations. ENVIRON performed air dispersion modeling to estimate hourly maximum gasoline concentrations using maximum hourly TOG emission rates. Table 3-1b also includes the maximum hourly TOG emission rates for gasoline sources used to estimate maximum one-hour TAC concentrations.

Table 3-2 outlines the annual DPM and TAC emissions estimated for each of the main source categories described in this section and their contribution to the total DPM and gasoline TOG and PM emissions. The emissions for each of the activities were distributed spatially and temporally over the range of operations as described in more detail in Section 4.

4.0 AIR DISPERSION MODELING

ENVIRON performed air dispersion modeling to estimate exposure concentrations from the dispersion of DPM and TAC emissions from routine operational sources at San Bernardino. ENVIRON evaluated DPM emissions from locomotive and on- and off-road diesel engines as well as TAC emissions from gasoline engines. Air dispersion modeling requires the selection of an appropriate dispersion model and input data based on regulatory guidance, common industry standards/practice, and/or professional judgment. As stated previously, ENVIRON performed air dispersion modeling generally consistent with previous studies and guidance documents (ARB 2004, 2005a, 2005c, 2006a and USEPA 2000, 2004a, 2004b, 2005a, 2005b) based on the information available at the time of the assessment. The type of air dispersion model and modeling inputs (i.e., pollutants to be modeled with appropriate averaging times, source characterization and parameters, meteorological data, building downwash, terrain, land use, and receptor locations) that we used in the air dispersion modeling for San Bernardino are discussed below.

4.1 Model Selection and Model Control Options

As discussed in the Introduction, ENVIRON used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD version 07026) to estimate airborne concentrations resulting from DPM and TAC emissions from the BNSF San Bernardino Yard as recommended in the draft Guidelines (ARB 2006a) and USEPA air dispersion modeling guidelines (2005b). AERMOD was developed as a replacement for USEPA's Industrial Source Complex (ISC) air dispersion model to improve the accuracy of air dispersion model results for routine regulatory applications and to incorporate the progress in scientific knowledge of atmospheric turbulence and dispersion. This change was made in November 2005 (USEPA 2005a). Starting in November 2006, ISC was no longer considered a USEPA-approved model for certain regulatory applications. Both models are near-field, steady-state Gaussian plume models, and use site-representative hourly surface and twice-daily upper air meteorological data to simulate the effects of dispersion of emissions from industrial-type releases (e.g., point, area, and volume) for distances of up to 50 kilometers (USEPA 2005b).

AERMOD is appropriate for use in estimating ground-level short-term ambient air concentrations resulting from non-reactive buoyant emissions from sources located in simple and complex terrain. ENVIRON conducted the air dispersion analysis using AERMOD in the regulatory default mode, which includes the following modeling control options:

- adjusting stack heights for stack-tip downwash (except for building downwash cases),

- incorporating the effects of elevated terrain,
- employing the calms processing routine, and
- employing the missing data processing routine.

4.2 Modeled Pollutants and Averaging Periods

Calculation of chemical concentrations for use in exposure analysis requires the selection of appropriate concentration averaging times. ENVIRON based the selection of appropriate averaging times on the toxicity criteria data developed by the California Environmental Protection Agency (CalEPA).

For DPM, CalEPA has developed toxicity criteria for both carcinogenic and chronic non-carcinogenic effects (CalEPA 2005a, 2005b). Therefore, ENVIRON estimated the period-average DPM concentration over the span of the meteorological data for ARB's use in estimating cancer and chronic non-cancer risk. ENVIRON did not calculate maximum short-term concentrations (one-hour averages) for DPM as an acute toxicity criteria for DPM has not been developed by the CalEPA (i.e., no acute reference exposure level (REL) is listed) (CalEPA 2000).

ENVIRON evaluated a large number of non-DPM TACs in this assessment from non-DPM sources (mainly from gasoline engine emissions) as identified in the speciation profiles discussed in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b). ENVIRON estimated both annual-average and maximum one-hour concentrations for each non-DPM TAC. In order to substantially reduce modeling complexity and run time, maximum one-hour TOG exhaust, TOG evaporative, and PM exhaust emission rates (as opposed to maximum one-hour individual TAC emission rates) were input into the air dispersion model. Speciation profiles containing the fractions of individual TACs for TOG exhaust, TOG evaporative, and PM exhaust emissions, discussed in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b), were then applied to the TOG exhaust, TOG evaporative, and PM exhaust concentrations estimated by the dispersion model to calculate concentrations of individual TACs. This methodology resulted in conservative estimates (i.e., over-predictions) of the maximum one-hour concentrations for individual TACs.

4.3 Source Characterization and Parameters

Source characterization, location, and parameter information is necessary to model the dispersion of air emissions. ENVIRON modeled DPM and other TAC emissions from operational sources at San Bernardino, as described above. In general, we determined source locations from the activity information discussed in Section 2, facility plot plans, information provided by BNSF personnel and contractors, and/or recent aerial photographs of the facility and surrounding areas. ENVIRON accounted for temporal (i.e., hourly, daily, and/or seasonal) variations in activities and emissions from each source by using variable hourly, daily, and seasonal emission factors where available. ENVIRON represented emissions from locomotive sources, vehicular sources, and mobile equipment sources as one of the following source types, and generally consistent with the draft Guidelines (ARB 2006a), where possible:

- Point source (a source with emissions emanating from a known point, with buoyancy due to either thermal or mechanical momentum). A point source is characterized by a height, diameter, temperature, and exit velocity.
- Volume source (a source with emissions that have no buoyancy and are emanated from a diffuse area). A volume source is characterized by an initial lateral and vertical dimension (initial dispersion) and a release height.
- Area source (a source with emissions that have no buoyancy and are emanated from a diffuse plane or box). An initial vertical dimension and release height may also be specified for an area source.

ENVIRON used point sources to model emissions from stationary idling locomotive source activities. ENVIRON used volume sources to represent emissions from moving sources along specific pathways (e.g., moving locomotives, trucks, and off-road equipment). ENVIRON used area sources to represent emissions from mobile equipment and vehicles operating over large areas. Additional details regarding the characterization of sources, source locations, and modeling parameters for each source category discussed in Section 3.0 are described below.

4.3.1 Locomotives at the Facility

4.3.1.1 Stationary Idling Locomotives

ENVIRON represented DPM emissions from stationary locomotive refueling, switching, arriving-departing line-haul, passing line-haul, and passenger locomotive activities by point sources spaced approximately every 50 meters similar to ARB's Roseville Study (ARB 2004). ENVIRON placed point sources along railway lines at San Bernardino in areas where stationary idling activities occur, staggering point sources on adjacent parallel railway lines. The locations of point sources representing stationary locomotive activities are shown in Figures 4-1a through 4-1d. ENVIRON distributed emissions uniformly among the point sources comprising each stationary idling activity. Based on information from BNSF personnel, ENVIRON assumed that emissions from stationary locomotive switching, arriving-departing line haul and passing line-haul activities occur 24 hours per day, seven days per week. Locomotive idling while refueling and stationary passenger locomotive activities (i.e., Amtrak and Metrolink) generally occur less than 24 hours per day and seven days per week. Detailed temporal profiles for idling while refueling and passenger locomotive activities are presented in Appendix A. Table 3-1a summarizes the emissions and operating hours for each stationary locomotive activity. Variable hourly, daily, and seasonal emission factors were also applied to approximate the temporal variations in emissions from these sources. These variable emission profiles are summarized in electronic tables in Appendix A.

Facility personnel provided source parameter information (i.e., release height, velocity, temperature, and diameter), which was based on the specific locomotive types for each stationary idling activity. ENVIRON performed fleet-averaging of locomotive source parameters as recommended by the draft Guidelines (ARB 2006a) to reduce the large number of potential sources (from approximately 2735 to 725) related to the stationary locomotive activities at San Bernardino. Fleet-averaging of source parameters was performed by weighting the source parameters for each locomotive model type by the percentage of emissions from each locomotive model type for a given locomotive activity. Table 4-1 summarizes the fleet-average source parameters for stationary locomotive activities at San Bernardino.

4.3.1.2 Locomotive Movement

ENVIRON represented DPM emissions from locomotive movement activities, including locomotive crew change, switching, arriving-departing line-haul, passing line-haul, and passenger locomotives, by individual volume sources spaced approximately every 50 to 150 meters similar to ARB's Roseville Study (ARB 2004). ENVIRON selected larger volume source spacing for locomotive switching and arriving-departing movement activities than was previously used in ENVIRON's Air Dispersion Modeling Assessment of Air Toxic Emissions from BNSF Commerce/Mechanical Rail Yard ("BNSF Commerce/Mechanical") Report (ENVIRON 2006b), ENVIRON's Air Dispersion Modeling Assessment of Air Toxic Emissions from BNSF Richmond Rail Yard ("BNSF Richmond") Report (ENVIRON 2006c), and ENVIRON's Air Dispersion Modeling Assessment of Air Toxic Emissions from BNSF Commerce/Eastern Rail Yard ("BNSF Commerce/Eastern") Report (ENVIRON 2006d) to prevent overlap of larger volume sources covering multiple rail lines. ENVIRON placed sources along railway lines at San

Bernardino where movement activities occur. Figures 4-2a through 4-2d show the locations of modeled volume (movement) sources at the Facility. ENVIRON distributed emissions evenly among the volume sources comprising locomotive crew change, arriving-departing line haul, and passing line haul activities. Based on information from BNSF personnel, ENVIRON apportioned switching emissions in the following manner: 60% to classification yard in the "A" yard east of Mt. Vernon Avenue; 20% to the classification yard in "A" yard west of Mt. Vernon Avenue; and 20% to the classification yard in the "B" yard. Based on information from BNSF personnel, ENVIRON assumed that emissions from locomotive movement crew change, switching, arriving-departing line-haul, and passing line-haul activities occur 24 hours per day, seven days per week. Passenger locomotive movement activities (i.e., Amtrak and Metrolink) generally occur less than 24 hours per day and seven days per week. Detailed temporal profiles for passenger locomotive activities are presented in Appendix A. Table 3-1a summarizes the emissions and operating hours for each locomotive movement activity. Variable hourly, daily, and seasonal emission factors were also applied to approximate the temporal variations in emissions from these sources. These variable emission profiles are summarized in electronic tables in Appendix A.

For locomotive movement sources occurring along single rail lines, ENVIRON set the length of side for each volume source equal to the width of the fleet-average locomotive. In order to reduce modeling complexity and decrease model run-times, and in order to reduce the number of volume sources required to represent multiple parallel rail lines, ENVIRON used larger volumes with the length of side equal to the combined width of the rail lines plus the width of a locomotive. Because switching movement activities in the "A" and "B" yards are distinct activities, source spacing was determined separately for each yard. A source spacing of 150 meters was used in the "A" yard and a source spacing of 100 meters was used in the "B" yard to maximize the coverage in each operating area without resulting in overlap of adjacent volume sources. Because locomotive crew change and arriving-departing line haul movement activities occur over a continuous set of rail lines stretching across the Facility (i.e., through the "A" and "B" yards),[2] a uniform source spacing of 150 meters was used to represent locomotive crew change and arriving-departing line-haul activities. ENVIRON used a similar methodology (i.e., volumes with the length of side equal to the combined width of the rail lines plus the width of a locomotive) to represent converging or diverging rail lines,

[2] Rail lines in the central part of the classification yard in the "A" yard are bisected by Mt. Vernon Avenue running north and south. To account for the discontinuity in rail activities near Mt. Vernon Avenue, an additional 75 meter gap was inserted between the volume sources on either side of Mt. Vernon Avenue.

resulting in progressively smaller volumes as the rail lines converged and progressively larger volumes as rail lines diverged. ENVIRON performed sensitivity analyses to evaluate the use of a single set of larger volume sources versus multiple sets of smaller volume sources along multiple parallel rail lines and converging rail lines. These sensitivity analyses demonstrated that the use of larger volume sources with 50-meter source spacing generally resulted in receptor concentrations within five percent of the receptor concentrations predicted by the multiple sets of smaller volume sources and smaller source spacing. The results of these sensitivity analyses are discussed in more detail in Appendix C of ENVIRON's BNSF Commerce/Mechanical Report (ENVIRON 2006b). ENVIRON calculated the corresponding initial lateral dimension of each volume source from USEPA guidance (USEPA 2004b).

ARB accounted for buoyancy effects of exhaust from locomotive movement activities by calculating plume rise adjustments to the release height using USEPA's SCREEN3 model for all 11 different locomotive models considered in the study (ARB 2004). Due to variability in locomotive travel speeds, hourly wind speeds, and hourly stability class, a potentially large uncertainty is associated with these plume rise adjustments. ENVIRON also calculated plume rise adjustments to the release height using the SCREEN3 model and a methodology similar to that of ARB (ARB 2004). Due to the uncertainty associated with variable locomotive speeds, hourly wind speeds, and hourly stability class, plume rise adjustments were calculated based on fleet-average locomotive parameters for individual locomotive activities. For source activities with multiple notch settings (e.g., locomotive switching), ENVIRON selected plume rise predictions based on fleet-average source parameters for the single notch setting with the highest percentage of activity emissions. For movement activities with a range of locomotive speeds, the wind speed in SCREEN3 was set equal to the maximum locomotive speed, resulting in lower, more conservative plume rise adjustments. ENVIRON calculated the corresponding initial lateral dimension of each volume source from USEPA (USEPA 2004b) guidance. Tables 4-1 and 4-2 summarize the modeling source parameters, approximate travel speeds, and plume rise adjustments used for locomotive movement sources at San Bernardino. Electronic SCREEN3 input and output files used to determine plume rise adjustments are attached in Appendix B.

4.3.2 Cargo Iandling Equipment

4.3.2.1 Lift Machines

As lift machines operations may occur over a large area of the Facility, and as specific modeling source parameters were not available for lift machines, ENVIRON conservatively represented DPM emissions from lift machines by area sources as recommended by the draft Guidelines (ARB 2006a). ENVIRON placed area sources over areas where lift machine activities occur. According to BNSF facility personnel, all lift machine activities occur within the East and West Intermodal areas of the "A" yard. The locations of area sources representing lift machines are shown in Figure 4-3a. Emissions within this operating area were distributed with 80% of emissions in the East Intermodal area and 20% of emissions in the West Intermodal area based on information from BNSF personnel. ENVIRON assumed that emissions from lift machine activities occur 24 hours per day, seven days per week based on information from BNSF personnel. Table 3-1a summarizes the DPM emissions and operating hours for lift machines at San Bernardino.

Model-specific source parameter information (i.e., release height, velocity, temperature, and diameter) was not available for lift machines at the San Bernardino Yard. In addition, source parameter information for lift machines at other intermodal Yards (e.g., the BNSF Hobart Yard) obtained from BNSF personnel varied considerably. Therefore, ENVIRON conservatively selected the upper end of the range of release heights (3.9 meters) from ARB's Port of Los Angeles/Port of Long Beach (POLA/POLB) Study (ARB 2005c) for use in the air dispersion modeling. ENVIRON did not consider plume rise for lift machines due to the large variation in measured release temperatures and velocities reported by BNSF personnel. The use of a potentially lower release height based on information from the ARB POLA/POLB Study and the exclusion of plume rise adjustments to the release height result in higher (more conservative) predictions of receptor concentrations. ENVIRON calculated the corresponding initial vertical dimension of each area source from USEPA (USEPA 2004b) guidance. Table 4-3 summarizes the modeling source parameters for lift machine activities at San Bernardino.

4.3.2.2 Cranes

As crane operation may occur over a large area of the Facility, and as specific modeling source parameters were not available for cranes, ENVIRON conservatively represented DPM emissions from cranes by area sources as recommended by the draft Guidelines

(ARB 2006a). ENVIRON placed area sources over areas where crane activities occur. According to BNSF facility personnel, all crane activities within the locomotive classification yard in the "A" yard. The locations of area sources representing cranes are shown in Figure 4-3b. Emissions within this operating area were distributed with 80% of emissions in the classification yard east of Mt. Vernon Avenue and 20% of emissions in the classification yard west of Mt. Vernon Avenue based on information from BNSF personnel. ENVIRON assumed that emissions from crane activities occur 24 hours per day, seven days per week based on information from BNSF personnel. Table 3-1a summarizes the DPM emissions and operating hours for cranes at San Bernardino.

Source parameter information (i.e., release height, velocity, temperature, and diameter) was not available for cranes. Therefore, ENVIRON assumed that source parameters for cranes were similar to lift machines and selected the upper end of the range of release heights (3.9 meters) for lift machines from ARB's Port of Los Angeles/Port of Long Beach (POLA/POLB) Study (ARB 2005c) for use in the air dispersion modeling. ENVIRON did not consider plume rise for cranes due to the large variation in measured release temperatures and velocities reported for lift machines by BNSF personnel. The use of a potentially lower release height based on information from the ARB POLA/POLB Study and the exclusion of plume rise adjustments to the release height result in higher (more conservative) predictions of receptor concentrations. ENVIRON calculated the corresponding initial vertical dimension of each area source from USEPA (USEPA 2004b) guidance. Table 4-3 summarizes the modeling source parameters for crane activities at San Bernardino.

4.3.2.3 Yard Vehicles and Iostlers

As yard vehicles and hostlers may operate throughout a majority of the "A' yard at the Facility, and as specific modeling source parameters were not available for yard vehicles and hostlers, ENVIRON conservatively represented DPM emissions from yard vehicles and hostlers by area sources as recommended by the draft Guidelines (ARB 2006a). ENVIRON placed area sources over areas where yard vehicle and hostler activities occur. According to BNSF facility personnel, yard vehicles and hostlers operate over the entire East and West Intermodal areas of the "A" yard as well as the northern portion of the classification yard in the "A" yard. The locations of area sources representing yard vehicles and hostlers are shown in Figure 4-3c. Emissions within this operating area were distributed with 80% of emissions in the East Intermodal area and classification yard east of Mt. Vernon Avenue and 20% of emissions in the West Intermodal area and classification yard west of Mt. Vernon Avenue based on information from BNSF personnel. ENVIRON assumed that emissions from yard vehicles and hostlers occur 24 hours per day, seven days per week based on information from BNSF personnel. Table 3-1a summarizes the DPM emissions and operating hours for yard vehicles and hostlers at San Bernardino.

Model-specific source parameter information (i.e., release height, velocity, temperature, and diameter) for yard vehicles and hostlers was not available from BNSF personnel. Therefore, ENVIRON assumed that emissions release characteristics for yard vehicles and hostlers were similar to on-road fleet vehicles, and used a release equal to 0.6 meters (i.e., the same release height as on-road fleet vehicles). ENVIRON also assumed that exhaust emissions from yard vehicles and hostlers were released horizontally, and that plume rise due to differences in temperature between the vehicle exhaust and ambient air was negligible. ENVIRON calculated the corresponding initial vertical dimension of each area source from USEPA (USEPA 2004b) guidance. Table 4-3 summarizes the modeling source parameters for yard vehicles and hostler activities at San Bernardino.

4.3.3 On-Road Container and Refueling Trucks

As described in Section 3.3, on-road container and refueling trucks included tractor-trailers trucks that receive or deliver containers to the intermodal areas at the Facility and refueling trucks that deliver fuel to the gasoline storage and dispensing facility and locomotives in the locomotive refueling area. ENVIRON represented DPM emissions from on-road container and refueling trucks by a combination of volume and area sources as recommended by the draft Guidelines (ARB 2006a) and in discussions with ARB staff.[3] ENVIRON used volume sources to represent container and refueling truck travel along specific pathways within the Facility. ENVIRON used area sources to represent on-road container and refueling truck travel and idling at the Facility ingress and egress and in areas of the Facility where the travel path(s) and idling areas were not well-defined (i.e., in the intermodal areas, and in the vicinity of the gasoline storage and dispensing facility). The use of area sources to represent on-road container and refueling truck idling emissions at the Facility ingress and egress is different from previous BNSF Rail Yards (i.e., Commerce-Eastern, Hobart, and Richmond), which used volume sources. Because unit emission rates were used in the modeling analysis and all idling emissions from on-road container and refueling trucks at the Facility (i.e., at the Facility ingress/egress and in the intermodal areas) were grouped into a single source group, the

[3] Personal communication. Gavin Hoch of ENVIRON by telephone with Jing Yuan of ARB on August 24, 2006.

consistent use of either volume or area sources was required for all operational areas. Because idling emissions in the intermodal areas occurred over large areas without well-defined travel paths and the quantity of idling emissions in the intermodal areas was approximately twice the idling emissions at the ingress/egress, area sources were selected for all container and refueling truck idling sources. If multiple source groups are need to distinguish impacts from idling emissions in different operational areas of the Facility, the selection of source type(s) for idling emissions from on-road container and refueling trucks can be refined. The use of area sources instead of volume sources results in conservative (i.e., higher) predicted concentrations. The locations of volume and area sources representing on-road container and refueling truck idling areas and travel pathways and areas are shown in Figures 4-4a and 4-4b, respectively.

BNSF facility personnel estimated that 80% of on-road container truck travel and on-site idling activity occurs in the East Intermodal Yard, and 20% of on-road container truck travel and on-site idling occurs in the West Intermodal area. BNSF personnel also provided idling emissions at the entrance and exit gates for both on-road container and refueling trucks. However, BNSF personnel did not have information specifying the approximate number of trucks or the percentage of emissions associated with particular travel paths for on-road container or refueling trucks. In addition, BNSF personnel did not have information indicating the percentage of emissions associated with specific travel paths versus travel areas for either on-road container or refueling trucks. In order to apportion emissions between travel paths and travel areas, ENVIRON estimated an average travel path length within each travel area (designated as "East Intermodal Area" and "West Intermodal Area" in Figure 4-4a and "On-road Refueling Truck Area" in Figure 4-4b), and assumed that total travel emissions were spread uniformly over all travel paths and travel areas based on the travel path length, with the exception of on-road container truck travel in the East and West Intermodal areas, as described above (i.e., 80% of on-road container truck emissions occurred in the East Intermodal area and 20% of on-road container truck emissions occurred in the West Intermodal area). Movement emissions along a given travel path or within a given travel area were also distributed uniformly. Based on information from BNSF personnel, ENVIRON assumed that on-site idling emissions (except emissions at the entrance and exit) could occur anywhere in the travel areas, with 80% of on-road container truck idling emissions occurring in the East Intermodal Area and 20% occurring in the West Intermodal Area. ENVIRON assumed that emissions from on-road container and refueling trucks occur 24 hours a day, seven days per week based on information from BNSF personnel. Table 3-

1a summarizes the DPM emissions and operating hours for on-road container and refueling trucks.

Model-specific source parameter information (i.e., release height, velocity, temperature, and diameter) for on-road container trucks was not available from BNSF personnel. Based on information from a previous ARB study (ARB 2000) and recommendations by ARB staff in 2006,[4] ENVIRON used a release height of 4.0 meters for on-road container truck idling and travel during the daytime (i.e., 6 a.m. to 6 p.m.) and a release height of 6.0 meters for nighttime (i.e., 6 p.m. to 6 a.m.) to account for plume rise. ENVIRON calculated the corresponding initial vertical dimension of each volume and area source from USEPA (USEPA 2004b) guidance. Table 4-3 summarizes the modeling source parameters for on-road container and refueling truck activities at San Bernardino.

4.3.4 On-Road Fleet Vehicles

ENVIRON represented DPM and gasoline TAC emissions from BNSF and non-BNSF (i.e., Eagle International and Progressive Rail Service) on-road fleet vehicles by a combination of volume and area sources as recommended by the draft Guidelines (ARB 2006a) and in discussions with ARB staff. ENVIRON used volume sources to represent on-road vehicle travel along specific pathways within the Facility. ENVIRON used area sources to represent on-road fleet vehicle travel in areas of the Facility where the travel path(s) and areas were not well-defined (e.g., in the intermodal areas, classification yard, and near the BNSF Administration Office). The locations of volume and area sources representing on-road fleet vehicle travel pathways and areas are shown in Figures 4-5a and 4-5b.

BNSF personnel did not have information specifying the approximate number of on-road fleet vehicles or the percentage of emissions associated with particular travel paths for on-road fleet vehicles. In addition, BNSF personnel did not have information indicating the percentage of emissions associated with specific travel paths versus travel areas for on-road fleet vehicles. In order to apportion emissions between travel paths and travel areas, ENVIRON estimated an average travel path length within each travel area and assumed that total travel emissions were spread uniformly over all specific travel paths and travel areas based on the travel path length. Movement emissions along a given travel path or within a given travel area were also distributed uniformly. ENVIRON assumed that emissions from all on-road vehicles occur weekdays (i.e., Monday through

[4] Personal communication. Gavin Hoch of ENVIRON by telephone with Pingkuan Di of ARB on August 31, 2006.

Friday) from 7 a.m. to 7 p.m. based on information from BNSF personnel. Tables 3-1a and 3-1b summarize the DPM and gasoline emissions, respectively, and operating hours for BNSF and non-BNSF on-road fleet vehicles.

Model-specific source parameter information (i.e., release height, velocity, temperature, and diameter) for BNSF and non-BNSF on-road fleet vehicles was not available from BNSF personnel. Based on information from a previous ARB study (ARB 2000) and recommendations by ARB staff,[5] ENVIRON used a release height of 0.6 meters for all on-road fleet vehicles. ENVIRON assumed that exhaust emissions from on-road fleet vehicles were released horizontally, and that plume rise due to differences in temperature between the vehicle exhaust and ambient air was negligible. ENVIRON calculated the corresponding initial vertical dimension of each volume and area source from USEPA (USEPA 2004b) guidance. Table 4-4 summarizes the modeling source parameters for BNSF and non-BNSF on-road fleet vehicle activities at the San Bernardino Yard.

4.3.5 Off-Road Equipment

4.3.5.1 Boxcar/Freight TRUs

As specific modeling source parameters were not available for boxcar/freight TRUs, and to ensure consistency with ENVIRON's modeling methodology for container/trailer TRUs, described below, ENVIRON conservatively represented DPM emissions from boxcar/freight TRUs in the "A" and "B" classification yards by area sources as recommended by the draft Guidelines (ARB 2006a). ENVIRON used volume sources to represent boxcar/freight TRU operation along specific rail lines within the Facility (i.e., on the main line between the "A" and "B" classification yards). ENVIRON placed area and volume sources over areas and rail lines where boxcar/freight TRU activities occur. According to BNSF facility personnel, boxcar/freight TRUs may be located along all rail lines, except those used exclusively by passenger trains and refueling locomotives. The locations of area and volume sources representing boxcar/freight TRUs are shown in Figure 4-6a. In order to apportion emissions between volume sources representing the main line between the "A" and "B" classification yard and area sources representing rail lines within the "A" and "B" classification yards, ENVIRON estimated the length of rail on the main lines between the "A" and "B" classification yards and the length of rail within the "A" and B" classification yards and assumed that total boxcar TRU emissions

[5] Personal communication. Gavin Hoch of ENVIRON by telephone with Pingkuan Di of ARB on August 31, 2006.

were spread uniformly over all rail lines based on the length of rail. ENVIRON assumed that emissions from boxcar/freight TRUs occur 24 hours per day, seven days per week, based on information from BNSF personnel. Table 3-1a summarizes the DPM emissions and operating hours for boxcar/freight TRUs at San Bernardino.

Source parameter information (i.e., release height, velocity, temperature, and diameter) for boxcar/freight TRUs was not available from BNSF personnel. ENVIRON assumed that the release height of a boxcar/freight TRU is the same as a container TRU (1.0 meters). ENVIRON conservatively estimated the release height of a container/trailer TRU, described below, based on photographs of container/trailer TRUs, and did not account for the elevated release height for multiple, vertically stacked containers or the height of the base of the container TRUs above the ground (i.e., the release height was based on the release point above the base of the container, not above the ground). This conservative assumption resulted in over-predictions of receptor concentrations. ENVIRON calculated the corresponding initial vertical dimension of each area source from USEPA (USEPA 2004b) guidance. Table 4-3 summarizes the modeling source parameters for boxcar/freight TRUs at the San Bernardino Yard.

4.3.5.2 Container/Trailer TRUs

As container/trailer TRUs may be located throughout the intermodal areas at the Facility, and as specific modeling source parameters were not available, ENVIRON conservatively represented DPM emissions from container/trailer TRUs by area sources as recommended by the draft Guidelines (ARB 2006a). ENVIRON placed area sources over areas where container/trailer TRU activities occur. According to BNSF facility personnel, container/trailer TRUs may be located anywhere where intermodal activities occur. The locations of area sources representing container/trailer TRUs are shown in Figure 4-6a. Emissions were distributed uniformly throughout the intermodal areas based on information from BNSF personnel. ENVIRON assumed that emissions from container/trailer TRUs occur 24 hours per day, seven days per week, based on information from BNSF personnel. Table 3-1a summarizes the DPM emissions and operating hours for container TRUs at the Facility.

Model-specific source parameter information (i.e., release height, velocity, temperature, and diameter) for container/trailer TRUs was not available from BNSF personnel. ENVIRON conservatively assumed the release height of a container TRU (1.0 meters) based on photographs of container TRUs, and did not account for the elevated release height for multiple, vertically stacked containers or the height of the base of the container TRUs above the ground for containers on trailers (i.e., the release height was based on the release point above the base of the container, not above the ground). This conservative assumption likely results in over-predictions of receptor concentrations. ENVIRON calculated the corresponding initial vertical dimension of each area source from USEPA (USEPA 2004b) guidance. Table 4-3 summarizes the modeling source parameters for container/trailer TRUs at San Bernardino.

4.3.5.3 Track Maintenance Equipment

As track maintenance equipment operations may occur over all rail lines at the facility (i.e., over the "A" and "B" classification yards, the locomotive refueling area, the main line, and passenger rail lines), and as specific modeling source parameters were not available for track maintenance equipment, ENVIRON conservatively represented DPM and gasoline TAC emissions from track maintenance equipment over larger areas (i.e., over rail lines in the "A" and "B" classification yards and the locomotive fueling area) by area sources as recommended by the draft Guidelines (ARB 2006a). ENVIRON used volume sources to represent track maintenance equipment operations along specific rail lines within the Facility (i.e., on the main line between the "A" and "B" classification yards and on rail lines exclusively used by passenger locomotives). ENVIRON placed area and volume sources over rail lines where track maintenance activities occur. The locations of area and volume sources representing track maintenance equipment are shown in Figure 4-6b. In order to apportion emissions between volume sources representing the individual rail lines and area sources representing rail lines within the "A" and "B" classification yards and the refueling area, ENVIRON estimated the length of rail on the individual rain lines and the length of rail within the "A" and B" classification yards and refueling area and assumed that total track maintenance equipment emissions were spread uniformly over all rail lines based on the length of rail. ENVIRON assumed that emissions from track maintenance activities occur weekdays (i.e., Monday through Friday) from 7 a.m. to 7 p.m. based on information from BNSF personnel. Tables 3-1a and 3-1b summarize the DPM and gasoline emissions, respectively, and operating hours for track maintenance equipment.

Model-specific source parameter information (i.e., release height, velocity, temperature, and diameter) for track maintenance equipment was not available from BNSF personnel. Because track maintenance equipment generally appeared to be similar in height to locomotives and have vertical emissions releases, ENVIRON assumed an average release height corresponding to the lowest moving locomotive release height adjusted for plume rise (i.e., the lowest adjusted release height in Table 4-2). ENVIRON calculated the corresponding initial vertical dimension of each area source from USEPA (USEPA 2004b) guidance. Table 4-3 summarizes the modeling source parameters for track maintenance equipment activities at San Bernardino.

4.3.6 Permitted Stationary Sources

4.3.6.1 Emergency Generator

Source parameter information (i.e., release height, velocity, temperature, and diameter) necessary to represent the emergency generator was not available from BNSF personnel, the engine manufacturers, or district permit applications and permits. Additionally, using a conservative emissions estimation methodology, the emergency generator accounted for only 0.4% of the total DPM emissions from the Facility. Due to the lack of source parameter information and the low percentage of total emissions from this source, the emergency generator was not included in the air dispersion modeling.

4.3.6.2 Gasoline Dispensing and Storage Facility

ENVIRON represented gasoline TAC emissions from the gasoline dispensing and storage facility as an area source as recommended by the draft Guidelines (ARB 2006a). The location of the area source representing the gasoline dispensing and storage facility is shown in Figure 4-7. ENVIRON assumed that emissions from the gasoline dispensing and storage facility (from fueling activities and breathing and working losses) occur 24 hours per day, seven days per week based on information from BNSF personnel. Table 3-1b summarizes the gasoline emissions and operating hours for the gasoline dispensing and storage facility.

Source parameter information (i.e., release height for evaporative losses from the storage tank and release height, velocity, temperature, and diameter for dispensing equipment) was not available for emission sources at the gasoline dispensing and storage facility. However, based on aerial photographs and discussions with BNSF personnel, the storage tank and dispensing equipment are both located above ground. In addition, the filling area and equipment is very similar to the equipment at a typical commercial filling station. Although evaporative emissions from the storage tank and dispensing equipment occur above ground level, the exact height of the release points for the emissions is unknown. Therefore, ENVIRON assumed a conservative release height of zero meters for emissions from the gasoline storage and dispensing facility. ENVIRON calculated the corresponding initial vertical dimension of the area source from USEPA (USEPA 2004b) guidance. Table 4-5 summarizes the modeling source parameters for the gasoline dispensing and storage facility at the San Bernardino Yard.

4.4 Meteorological Data

AERMOD requires a meteorological input file to characterize the transport and dispersion of pollutants in the atmosphere. Surface and upper air meteorological data inputs as well as surface parameter data describing the land use and surface characteristics near the site are first processed using AERMET, the meteorological preprocessor to AERMOD. The output file generated by AERMET is the meteorological input file required by AERMOD. Details of AERMET and AERMOD meteorological data needs are described in USEPA guidance documents (USEPA 2004a, 2004b). ENVIRON previously received ARB approval of the meteorological data selection and processing methods (ENVIRON 2007a). The remainder of this section only briefly describes the following two key aspects of the AERMET analysis: the surface and upper air meteorological data selected and the surface parameter evaluation for San Bernardino. ENVIRON has provided the raw meteorological data and the AERMOD model-ready meteorological data files as an electronic attachment in Appendix C.

4.4.1 Surface and Upper Air Meteorological Data

The focus of the HRA to be conducted by ARB is the characterization of risk in the areas immediately surrounding the San Bernardino Yard. As such, ENVIRON selected meteorological data for air dispersion modeling based upon their spatial and temporal representativeness of conditions in the immediate vicinity of the rail yard. As described in ENVIRON's report on meteorological data selection and processing methods previous approved by ARB (ENVIRON 2007a), ENVIRON selected the wind speed, wind direction, and temperature data from the South Coast Air Quality Management District (SCAQMD)-operated San Bernardino-4th Street station for the years 2000 through 2003 and 2005 as the most representative available wind speed, wind direction, and temperature data for use in the air dispersion analysis of the BNSF San Bernardino Rail Yards. However, subsequent to this approval, SCAQMD and ARB staff informed ENVIRON of potential issues related to the averaging algorithm used to generate hourly-averaged wind direction and wind speed data for surface meteorological data collected at the San Bernardino-4th Street station prior to 2005. Based on the recommendations of SCAQMD and ARB staff, ENVIRON used two calendar years of meteorological data (i.e., 2005 and 2006) to conduct air dispersion modeling of DPM emission activities at the San Bernardino Yard.

ENVIRON used cloud cover and pressure data from the National Weather Service's (NWS's) March Air Force Base from 2005 to 2006 as San Bernardino-4th Street did not have a record of pressure measurements for either 2005 or 2006. Upper air data from the San Diego Miramar Naval Air Station (NAS) was used in AERMET processing for the San Bernardino Yard (ENVIRON 2007a).

4.4.2 Surface Parameters

Prior to running AERMET, it is necessary to specify the surface characteristics for the meteorological monitoring site and/or the project area. The surface parameters include surface roughness, Albedo, and Bowen ratio, and are used to compute fluxes and stability of the atmosphere (USEPA 2004a) and require the evaluation of nearby land use and temporal impacts on these surface parameters. Surface parameters supplied to the model were specified for the area surrounding the surface meteorological monitoring site (i.e., San Bernardino meteorological station), rather than the project area (rail yard), as recommended by USEPA (USEPA 2005a) and ARB.[6] Because the selected meteorological station is in very close proximity to the San Bernardino Yard and the land use surrounding the meteorological station is very similar to the land use surrounding the San Bernardino Yard, surface parameters calculated for the meteorological station should be representative of the San Bernardino Yard.

In general, ENVIRON determined land-use sectors around the San Bernardino station using USGS land cover maps in conjunction with recent aerial photographs. ENVIRON then specified surface parameters for each using default seasonal values adjusted for the local climate. When a land-use sector consists of multiple land use types, ENVIRON used an area-weighted average of each surface parameter as recommended by USEPA (2004a). The locale-specific surface parameters used in this evaluation were described in ENVIRON's previous report to ARB (ENVIRON 2007a). Figure 4-8 shows the sectors ENVIRON selected around the San Bernardino-4th Street meteorological station for use in the AERMET processing and the USEPA land-use types within each sector. Table 4-6 summarizes the sector-specific surface parameters (surface roughness, Albedo, and Bowen ratio) determined for each of these sectors.

4.5 Building Downwash

Building downwash is the effect of structures on the dispersion of emissions from nearby point (stack) sources. As several point sources at the San Bernardino Yard were identified as adjacent to buildings, ENVIRON considered building downwash in this assessment. ENVIRON

[6] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

estimated building dimensions (i.e., location of building corners) based on information provided by BNSF personnel and contractors. Figure 4-9 shows the buildings evaluated as part of the building downwash analysis at San Bernardino. ENVIRON input building dimension information, summarized in Table 4-7, into USEPA's Building Profile Input Program - Plume Rise Model Enhancements (BPIP-PRIME) to account for potential building-induced aerodynamic downwash effects. The electronic input and output files for BPIP are provided in Appendix D. A sensitivity analysis was conducted in ENVIRON's BNSF Commerce/Mechanical Report (ENVIRON 2006b) to estimate the impact of building downwash from locomotive engines on stationary locomotive sources. This sensitivity analysis indicated that, at receptor distances close to the sources (i.e., within 100 meters), building downwash may have a large impact on the modeled concentrations. However, at distances further away from the sources (i.e., 400 to 700 meters), receptor concentrations for model runs with and without building downwash were similar (i.e., within 10% of each other). Based on the results of the sensitivity analysis, and the uncertainty in placing structures corresponding to stationary locomotives in areas where stationary locomotives occur, and the inherent uncertainty in concentration predictions near to stationary and mobile sources, as discussed in Section 5.0, building downwash effects from stationary locomotives were not considered in this assessment. The results of the sensitivity analysis are discussed in more detail in the Appendix F of ENVIRON's BNSF Commerce/Mechanical Report (ENVIRON 2006b).

4.6 Terrain

Another important consideration in an air dispersion modeling analysis is whether the terrain in the modeling area is simple or complex (i.e., terrain above the effective height of the emission point). ENVIRON used the following USGS 7.5 Minute digital elevation model (DEMs) information to identify terrain heights within the modeling domain:

- Devore
- Fontana
- Harrison Mountain
- San Bernardino East
- San Bernardino West
- Redlands
- Riverside East
- Riverside West
- Sunnyside

The electronic DEM files in the North American Datum (NAD) 1983 projection are provided in Appendix E. ENVIRON provided terrain elevation data to the AERMOD model using version 07026 of AERMAP, AERMOD's terrain preprocessor.

4.7 Land Use

AERMOD can evaluate heat island effects from urban areas to atmospheric transport and dispersion using an urban boundary layer option. ENVIRON analyzed the urban nature of the area in the vicinity of the San Bernardino Rail Yard using two different methods: Auer's method and population density calculations. The Auer method of classifying land use calls for analysis of the land within a three-kilometer radius from the primary project area to determine if the majority of the land can be classified as either rural (i.e. undeveloped) or urban (Auer 1978). If more than fifty percent of the area circumscribed by this three-kilometer radius circle consists of Auer land-use industrial, commercial or residential urban land types, then the urban boundary layer option is used in modeling. ENVIRON used both the USGS National Land Cover Data and the most recent USGS aerial photograph of the area surrounding the facility to determine that more than fifty percent of the area within three kilometers of San Bernardino Yard is urban, see Figure 4-1Oa. Consistent with AERMOD guidance (USEPA 2005a), ENVIRON also used population density calculations to determine whether the urban boundary layer option would be appropriate for BNSF San Bernardino. USEPA guidance calls for analysis of the population density within a three-kilometer radius from the primary project area to determine if the land can be classified as an urban (i.e., the average population density is greater than 750 people/km^2). Using year 2000 census data (Geolytics 2001), ENVIRON determined that the average population density for the area within three kilometers of the San Bernardino Yard is greater than 750 people/km^2 (see Figure 4-1Ob and Table 4-8) and that the area in the vicinity of the San Bernardino Yard should be considered urban. Based on the results of the Auer analysis and the population density analysis, ENVIRON selected the urban boundary layer option.

Selection of the urban boundary layer option in AERMOD requires also requires an estimate of the population of the urban area in order to make adjustments to the urban boundary layer. ENVIRON used published census data for the City of San Bernardino to determine the population (i.e., 195,357 people) as recommended by USEPA (USEPA 2005a). ENVIRON also provides electronic census data for the modeling domain (described in the next section) as an electronic attachment in Appendix F, as required in the draft Guidelines.

4.8 Receptor Locations

ENVIRON used gridded receptor points surrounding the BNSF San Bernardino Yard in the air dispersion analysis. These gridded receptor points represent the general population in the vicinity of the BNSF San Bernardino Yard, which includes both residential and commercial populations. However, these receptors do not necessarily represent the specific locations of the residential and commercial populations in the vicinity of the BNSF San Bernardino Yard. ENVIRON used three sets of discrete Cartesian receptor grid points around the Facility in the air dispersion modeling. The spacing and sizes of the Cartesian receptor grids were determined based on a screening sensitivity analysis, discussed in more detail in Appendix G. The Cartesian receptors included a fine receptor grid with spacing of 50 meters out to a distance of approximately 500 meters from the Facility boundary, a medium receptor grid with spacing of 250 meters out to a distance of approximately 1,500 meters from the Facility boundary, and a coarse receptor grid with spacing of 500 meters out to approximately ten kilometers from the Facility boundary. ENVIRON used Facility plot plans and other information provided by BNSF facility personnel to locate the Facility boundary. Receptors inside the facility boundary were removed prior to the air dispersion modeling analysis. The locations of the coarse, medium, and fine receptor grid points are shown in Figures 4-11a, 4-11b, and 4-11c, respectively. Discrete receptor points were generated from each of the grids shown in Figures 4-11a, 4-11b, and 4-11c. The air dispersion modeling analysis did not include receptors at the Facility boundary.

In accordance with the draft Guidelines (ARB 2006a), ENVIRON also evaluated individual receptor points at off-site locations within one mile of the Facility corresponding to sensitive receptors, including schools, hospitals, and daycare centers. Sensitive receptor locations were identified from searches of the following sources:

- California Department of Education, California School Directory
  http://www.cde.ca.gov/re/sd/
- The Automated Licensing Information and Report Tracking System (Hospitals and Licensed Care Facilities)
  http://alirts.oshpd.ca.gov/AdvSearch.aspx
- Yellow Pages
  http://yp.yahoo.com

These on-line databases were searched for the following zip codes in the cities of San Bernardino, Colton, and Rialto:
92324 92376 92401 92405 92408 92410 92411

The sensitive receptor locations identified from the search of these data sources and within one mile of the Facility are listed in Table 4-9.

Electronic census data was provided for the modeling domain in accordance with the draft Guidelines (ARB 2006a). These data, provided on a census-block level, were obtained from the GeoLytics CensusCD 2000 (GeoLytics 2001), and provided in electronic shapefile format in Appendix F.

4.9 Air Dispersion Modeling Results

ENVIRON calculated the air concentration of each TAC at each of the receptor locations discussed in Section 4.8. ENVIRON modeled DPM and TAC sources using unit emission rates (i.e., one gram per second) to estimate period-average dispersion factors for DPM and TACs corresponding to meteorological years 2005 and 2006. These period-average dispersion factors for DPM and TACs were combined with source-specific emission rates to generate period-average concentrations for the meteorological period 2005 through 2006. ENVIRON also modeled all non-DPM TAC sources using hourly-maximum evaporative TOG, exhaust TOG, and exhaust PM emission rates in order to estimate one-hour maximum evaporative TOG, exhaust TOG, and exhaust PM concentrations for the meteorological period 2005 through 2006. ARB speciation profiles for evaporative TOG, exhaust TOG, and exhaust PM were applied to estimate chemical-specific one-hour maximum concentrations at each receptor. It should be noted that this method results in an over-prediction of maximum one-hour concentrations of individual constituents at each receptor, as discussed in the uncertainty section below. Electronic AERMOD input and output modeling files are included in Appendix H. The methodology used to calculate period-average DPM and gasoline TAC air concentrations and hourly-maximum gasoline TAC air concentrations, and the electronic database tables used in these calculations are provided in Appendix I. Appendix I also contains the electronic database tables containing DPM and gasoline TAC period-average concentrations at each receptor and one-hour maximum gasoline TAC concentrations at each receptor for the modeled meteorological period modeled.

5.0 UNCERTAINTIES

Understanding the degree of uncertainty associated with each component of a risk assessment is critical to interpreting the results of the risk assessment. As recommended by the National Research Council (NRC 1994), [a risk assessment should include] "a full and open discussion of uncertainties in the body of each EPA risk assessment, including prominent display of critical uncertainties in the risk characterization." The NRC (1994) further states that "when EPA reports estimates of risk to decision-makers and the public, it should present not only point estimates of risk, but also the sources and magnitude of uncertainty associated with these estimates." Similarly, recommendations to CalEPA on risk assessment practices and uncertainty analysis from the Risk Assessment Advisory Committee (RAAC) were adapted from NRC recommendations (RAAC 1996). Thus, to ensure an objective and balanced characterization of risk and to place the risk assessment results in the proper perspective, the results of a risk assessment should always be accompanied by a description of the uncertainties and critical assumptions that influence the key findings of the risk assessment.

In accordance with the recommendations described above and as required in the draft Guidelines (ARB 2006a), ENVIRON has evaluated the uncertainties associated with the first two steps of an HRA: (1) emissions estimation and (2) air dispersion modeling. The uncertainties and critical assumptions associated with these steps are described below. Consistent with the Agreement, ARB will complete the third major part of the HRA which consists of estimating the risks for each of the designated rail yards and evaluating the uncertainties associated with the risk characterization component of the HRA (ARB 2005b). As noted in the Agreement, specific objectives of the HRAs to be conducted by ARB include developing a basis for risk communication, including describing the uncertainties associated with the key findings of the risk assessment. At the request of ARB, ENVIRON will assist ARB in identifying the critical assumptions and uncertainties associated with the risk characterization step of the HRA. This uncertainty evaluation will be conducted concurrent with the ARB risk characterization activities and will be provided to ARB in a separate submittal.

The following section summarizes the critical uncertainties associated with the emissions estimation and air dispersion modeling components of the risk assessment.

5.1 Estimation of Emissions

The uncertainties associated with emissions estimates and projections include uncertainties in activity and emission rates for the base year as well as projected future years. Although future year emissions were not evaluated in this assessment, the residential and worker risk scenarios will be evaluated for 70-year and 40-year periods, respectively, at a minimum by ARB. Thus, uncertainty due to future changes in activity and emission rates will be generally discussed. The uncertainty in activity and emissions estimates applies to both locomotive and non-locomotive sources.

For locomotive sources, the activity rates include primarily the number of engines operating and time in modes. The number of engines operating in the facility and on the main line are accurately measured and counted at readers, but the readers are not necessarily located exactly at the site under study, and can under certain circumstances produce erroneous duplicate readings that could only be accounted for via rough approximation. A separate and less accurate dataset was used to estimate the number of engines arriving and departing from a site. These data, however, often do not produce matching arrivals and departures. ENVIRON adopted a conservative approach based on using the higher of the arrival or departure numbers, which may have resulted in overestimates of the number of engines arriving.

Uncertainties also exist in estimates of the engine time in mode. Idling is typically the most significant operational mode, but locomotive event recorder data could not distinguish between idling with the engine on and idling with the engine off. As a result, ENVIRON used professional judgment to distinguish between these two modes. In addition, no idle time reduction was assumed in the future year scenarios, despite the fact that BNSF has initiated programs to reduce idling through installation of automatic start/stop devices and other operational changes to reduce idling. So while the current operations may not be precisely known, control measures already being implemented are expected to result in reduced activity levels and lower emissions than are estimated here for future years.

The most significant non-locomotive sources at the San Bernardino Facility are on-road trucks, cargo handling equipment, and transportation refrigeration units. Activity levels of these vehicles and equipment are estimated relatively accurately, however the duty cycles (engine load demanded) are less well characterized. Default estimates of the duty cycle may not accurately reflect the typical duty demanded from these vehicles and equipment at the San Bernardino Facility. New emissions models for these sources have recently been provided for use in this study by ARB. In many cases, these revised models reflect a dramatic change in emission factors from previous versions of the models and it is therefore reasonable to expect that future revisions to these models may result in further changes to emission estimates for on-road and off-road engines. In addition, national and state regulations have targeted these sources for emission reductions. Implementation of these rules and fleet turnover to newer engines meeting more strict standards should significantly reduce emissions at these rail sites in future years. The effects of these regulations have, for the most part, not been incorporated in the emission estimates, and so estimated emissions are greater than those expected for future years at the same activity level.

5.2 Estimation of Exposure Concentrations

5.2.1 Estimates from Air Dispersion Models

As discussed in Section 4.0, USEPA-recommended dispersion model AERMOD was used to estimate annual average off-site chemical exposure concentrations at the various off-site receptor locations. This model uses the Gaussian plume equation to calculate ambient air concentrations from emission sources. For this model, the magnitude of error for the maximum concentration is estimated to range from 10 to 40% (USEPA 2005b). Therefore, off-site exposure concentrations used in this assessment represent approximate off-site exposure concentrations.

5.2.2 Source Placement

Uncertainty exists in the placement of emission sources at the Facility. As a large amount of locomotive and on- and off-road engine activity at a rail yard is engaged in movement, the distribution of emissions during movement in the yards is an important source of uncertainty. Unlike fixed stationary sources, emissions from movement would occur over a continuum rather than as discrete points. However, regulatory approved models were originally developed for the evaluation of fixed stationary sources and the use of a continuum of source locations to model emissions during movement of sources results in an unacceptably large number (in the tens of thousands) of sources that would result in unwieldy post-processing data needs and unacceptable modeling run times (on the order of months rather than hours or days).

In this assessment, most point and volume sources were spaced evenly at approximately 50-meter intervals, similar to ARB's Roseville Study (ARB 2004) over rail locations where locomotive and on- and off-road activities occurred. Closer spacing between point and volume sources may impact the predicted concentrations at receptor locations near the Facility boundary. Sensitivity analyses performed to determine the potential impact of source placement on predicted concentrations at receptors near the Facility boundary (see Appendix C of ENVIRON's BNSF Commerce/Mechanical Report [ENVIRON 2006b]) indicated that concentrations at receptors nearest to the specific emission sources could be over-predicted by at least 10 percent.

5.2.3 Source Representation

The source parameters (i.e., release velocity and release temperature) used to model stationary locomotive activities are sources of uncertainty. Following ARB guidance (ARB 2006a), fleet-average source parameters were calculated to reduce the large number of potential source parameter configurations related to stationary locomotive activities at San Bernardino. The specific methodology used for calculating fleet-averaged source parameters is presented in Section 4.3.1.1. The use of fleet-average source parameters for stationary locomotive activities resulted in approximate predictions for these sources.

The release heights and vertical dimensions used for movement sources at the Facility are also sources of uncertainty. ARB calculated adjustments to the release height and vertical dimension for movement sources for individual engine models based on locomotive notch settings (i.e., locomotive travel speeds) and using two different stability classes for their Roseville study (ARB 2004). This methodology resulted in several uncertainties. ARB's methodology assumed that the wind speed was equal to the locomotive speed and did not account for variability in either the locomotive speed or hourly wind speeds. In addition, ARB's methodology assumed only two stability classes (i.e., class "D" for daytime and class "F" for nighttime), and did not account for potential variability in stability class during these time periods based local meteorological data. Nevertheless, ENVIRON calculated plume rise adjustments using a methodology similar to ARB's, described in more detail in Section 4.3.1.2, for locomotive movement activities and on- road diesel and gasoline vehicle movement sources at the Facility. Thus, the use of plume rise adjustments resulted in approximate predictions of receptor concentrations for these sources.

The use of area sources to represent emissions sources operating in areas where travel paths are not well defined or equipment usage may occur over the entire operating area are additional sources of uncertainty related to source representation. At the BNSF San Bernardino Yard, area sources were used to represent cargo handling equipment, transportation refrigeration units, on-road container and refueling truck idling and movement, on-road fleet vehicle movement, and track maintenance equipment, which account for approximately 50 percent of total DPM emissions from the Rail Yard. Based on guidance in the draft Guidelines (ARB 2006a), these source activities may be modeled as either area or volume sources. The AERMOD model uses very different methodologies to estimate dispersion from area and volume sources (USEPA 2004c), and the use of area sources generally results in higher (more conservative) concentration estimates. Thus, the use of area sources to represent cargo handling equipment, transportation refrigeration units, on-road container and refueling truck idling and movement, on-road fleet vehicle movement, and track maintenance equipment at San Bernardino generally resulted in over-predictions of receptor concentrations for these source activities.

5.2.4 Meteorological Data Selection

Uncertainty also exists in the meteorological data used in the AERMOD air dispersion model. These uncertainties are related to the use of meteorological data that is not site-specific, combination of surface data from two meteorological stations, substitution of missing meteorological data, and use of surface parameters for the meteorological station as opposed to the rail yard.

ENVIRON selected meteorological data for air dispersion modeling based upon their spatial and temporal representativeness of conditions in the immediate vicinity of the rail yard. On-site meteorological data was not available for the rail yard. Therefore, the meteorological data used in this analysis was based on surface meteorological data from ARB's San Bernardino-4th Street station (approximately four kilometers from the rail yard) and the NCDC/NWS station at March Air Force Base (approximately 20 kilometers from the rail yard) and upper air data from San Diego-Miramar Naval Air Station. A complete set of surface meteorological data was not available at ARB's San Bernardino-4th Street station; therefore wind speed, wind direction, and temperature data from San Bernardino-4th Street were combined with pressure and cloud cover data from March Air Force Base. Meteorological surface measurements from the San Bernardino-4th Street and March Air Force Base stations were not 100% complete for all modeled years, therefore missing data were substituted using procedures outlined in Atkinson & Lee (1992). Surface parameters supplied to AERMET, the meteorological preprocessor to AERMOD, were specified for the area surrounding the meteorological monitoring site (San Bernardino-4th Street station), rather than the project area (rail yard), as recommended by USEPA (USEPA 2005a) and ARB.[7] However, because the selected meteorological station is in very close proximity to the San Bernardino Yard and the land use surrounding the meteorological station is very similar to the land use surrounding San Bernardino, surface parameters calculated for the meteorological station should be representative of San Bernardino. The uncertainties due to the use of non-site-specific meteorological data, combination of surface data from different stations, substitution of missing surface data, and use of surface parameters for the meteorological station resulted in approximate exposure concentrations.

[7] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

5.2.5 Building Downwash

The spacing and placement of point sources relative to buildings or structures results in impacts to building downwash parameters and resulting modeling concentrations. Based on the results of ENVIRON's sensitivity analyses discussed in Appendix G of ENVIRON's BNSF Commerce/Mechanical Report (ENVIRON 2006b), the uncertainty in placing locomotive structures in areas where stationary locomotives occur, and the fact that many of the stationary locomotive activities occur in the interior of the rail yard, ENVIRON did not include building downwash effects due to locomotives in this assessment. Also, because specific locations for most stationary locomotive activities were not available, point sources representing these activities were distributed evenly over the areas where these operations occurred, as described in Section 4.3.1.1. These assumptions and modeling techniques resulted in approximate predictions of receptor concentrations near the facility boundary, as described in further detail below.

5.2.6 Uncertainty in Points of Maximum Impact

Receptor concentration estimates in close proximity to the facility, such as any potential point of maximum impact (PMI), are highly dependent on air dispersion modeling assumptions. That is, different modeling assumptions regarding the spatial and temporal distributions of the emission sources can greatly influence the resulting concentration estimates in proximity to the emission sources, including the magnitude and location of the PMI. As discussed in Section 5.2.2, there is significant uncertainty associated with identification of and estimation of impacts at locations near to a mobile source facility due to the complexity associated with modeling sources that can move (i.e., volume or line sources representing mobile sources). The potential influence of modeling techniques used in this assessment were evaluated in a sensitivity analyses performed for two different movement activities at Commerce/Mechanical, presented in Appendix C of ENVIRON's BNSF Commerce/Mechanical Report (ENVIRON 2006b). These two analyses illustrated the particular sensitivities in assessment of receptors near a rail yard's boundary to source representation (i.e., source spacing, and source sizing for approximation of mobile sources) in the modeling and how source simplification assumptions generally result in over-prediction of concentrations near to the rail yards. Other modeling techniques and assumptions used in this assessment, including fleet-averaging of stationary locomotive activity source parameters, plume rise adjustments to locomotive and on-road diesel and gasoline vehicle movement sources, the use of area sources to represent emissions sources operating in areas where travel paths are not well defined or equipment usage may occur over the entire area, as described above, also contribute to uncertainty to modeling predictions for receptors near the boundary of the rail yard.

Focusing on receptor locations at a greater distance (i.e., one to two kilometers) from the facility reduces the overall influence on the proximity to specific site operations. The two sensitivity analyses discussed above, and presented in more detail in ENVIRON's BNSF Commerce/Mechanical Report (ENVIRON 2006b), indicated that concentrations were over-predicted by 21% and 17% at the PMI. However, at distances one to two kilometers from the facility, receptor concentrations for the two source configurations were all within one to five percent of each other. Thus, the results of these two sensitivity analyses indicated that concentrations at receptors further from the sources are much less sensitive to air dispersion assumptions regarding the spatial and temporal distributions of emission sources.

5.2.7 Estimation of Maximum One-Iour TAC Concentrations

ENVIRON evaluated a large number of non-DPM TACs in this assessment from non-DPM sources (mainly from gasoline engine emissions) as identified in the speciation profiles discussed in ENVIRON's San Bernardino TAC Emissions Inventory (ENVIRON 2007b). In order to substantially reduce modeling complexity and run time, maximum one-hour TOG exhaust, TOG evaporative, and PM exhaust emission rates (as opposed to maximum one-hour individual TAC emission rates) were input into the air dispersion model. Speciation profiles containing the fractions of individual TACs for TOG exhaust, TOG evaporative, and PM exhaust emissions (discussed in San Bernardino TAC Emissions Inventory) were then applied to the TOG exhaust, TOG evaporative, and PM exhaust concentrations estimated by the dispersion model to calculate concentrations of individual TACs. This methodology resulted in conservative estimates (i.e., over-predictions) of the maximum one-hour concentrations for individual TACs.

5.3 Risk Characterization

As stated previously, ARB will conduct the risk characterization part of the HRA based on the results of the emissions estimation and air dispersion modeling provided by ENVIRON. Consistent with the Agreement and draft Guidelines *(*ARB 2005b, 2006a), the risk characterization activities conducted by ARB will include evaluating and reporting the uncertainties associated with the estimated risks for each designated rail yard. As discussed in detail above, there are many uncertainties associated with the estimation of emissions and exposure point concentrations from rail yard emission sources that would be in addition to the uncertainties associated with the exposure assumptions and toxicity information to be used in ARB's estimation of risks. Many of these uncertainties lead to an over-prediction of the estimated offsite impacts. At the request of ARB, ENVIRON will assist ARB in identifying the critical assumptions and uncertainties associated with the risk characterization step of the HRA.

This evaluation will be conducted concurrent with the ARB risk characterization activities and will be provided to ARB in a separate submittal.

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Table 2-1

Percentages of Land Use Categories Within Twenty Kilometers of Facility

BNSF San Bernardino Rail Yard

San Bernardino, California

Land Use Category [1]	Percentage (%)
Open Water	0.15%
Developed, Open Space	15.57%
Developed, Low Intensity	19.15%
Developed, Medium Intensity	17.94%
Developed, High Intensity	0.37%
Barren Land (Rock/Sand/Clay)	0.96%
Deciduous Forest	0.01%
Evergreen Forest	6.24%
Mixed Forest	1.79%
Shrub/Scrub	24.44%
Grassland/Herbaceous	11.72%
Pasture/Hay	0.24%
Cultivated Crops	1.23%
Woody Wetlands	0.19%
Emergent Herbaceous Wetlands	0.00%

Notes:

1 Land use data are based on National Land Cover Data 2001 from US Geological Survey.

Table 3-1a

Summary of Emissions and Operating Hours for Modeled DPM Emission Sources[1] BNSF San Bernardino Rail Yard

San Bernardino, California

Emission Source	Activity Category	Activity Category Description	Activity Sub-Category	Activity Sub-Category Description	Modeling Source Type	Operation Mode	Modeling Source Group[2]	Total Emissions (g)	Days of Operation per week[3]	Hours of Operation per day[3]	Hours of Operation per year	Modeled Area (m^2)	Total Emission Rate[4,5] (g/s) or ($g/m^2/s$)	Number of Modeled Sources	Emission Rate Applied to Period-Average Dispersion Factors[6] (g/s)
Locomotives	A	Idling While Refueling	A2	Idling While Refueling	Point	Idle	A2T	354,369	7	12	4,380		1.12E-02	22	5.11E-04
	C	Arriving and Departing Trains - Crew Change	C	Crew Change	Point	Idle	CT	30,990	7	24	8,760		9.83E-04	292	3.37E-06
					Volume	Dynamic Brake	CV	21,023	7	24	8,760		6.67E-04	28	2.38E-05
					Volume	Notch 1	CV	3,861	7	24	8,760		1.22E-04	28	4.37E-06
					Volume	Notch 2	CV	16,506	7	24	8,760		5.23E-04	28	1.87E-05
					Volume	Notch 3	CV	26,251	7	24	8,760		8.32E-04	28	2.97E-05
					Volume	Notch 4	CV	20,856	7	24	8,760		6.61E-04	28	2.36E-05
					Volume	Notch 5	CV	15,296	7	24	8,760		4.85E-04	28	1.73E-05
					Volume	Notch 6	CV	8,639	7	24	8,760		2.74E-04	28	9.78E-06
					Volume	Notch 7	CV	11,098	7	24	8,760		3.52E-04	28	1.26E-05
					Volume	Notch 8	CV	16,964	7	24	8,760		5.38E-04	28	1.92E-05
	D	Switching	D	Switching	Point	Idle	DT	2,320,969	7	24	8,760		7.36E-02	238	3.09E-04
					Volume	Dynamic Brake	DV	81,216	7	24	8,760		2.58E-03	29	8.88E-05
					Volume	Notch 1	DV	77,113	7	24	8,760		2.45E-03	29	8.43E-05
					Volume	Notch 2	DV	225,278	7	24	8,760		7.14E-03	29	2.46E-04
					Volume	Notch 3	DV	206,596	7	24	8,760		6.55E-03	29	2.26E-04
					Volume	Notch 4	DV	144,453	7	24	8,760		4.58E-03	29	1.58E-04
					Volume	Notch 5	DV	81,230	7	24	8,760		2.58E-03	29	8.88E-05
					Volume	Notch 6	DV	78,424	7	24	8,760		2.49E-03	29	8.58E-05
					Volume	Notch 7	DV	110,249	7	24	8,760		3.50E-03	29	1.21E-04
					Volume	Notch 8	DV	355,783	7	24	8,760		1.13E-02	29	3.89E-04
	E	Arriving and Departing Trains	E	Arriving Departing Line Haul	Point	Idle	ET	1,180,785	7	24	8,760		3.74E-02	292	1.28E-04
					Volume	Dynamic Brake	EV	109,392	7	24	8,760		3.47E-03	28	1.24E-04
					Volume	Notch 1	EV	347,990	7	24	8,760		1.10E-02	28	3.94E-04
					Volume	Notch 2	EV	483,677	7	24	8,760		1.53E-02	28	5.48E-04
					Volume	Notch 3	EV	586,145	7	24	8,760		1.86E-02	28	6.64E-04
					Volume	Notch 4	EV	224,981	7	24	8,760		7.13E-03	28	2.55E-04
					Volume	Notch 5	EV	171,961	7	24	8,760		5.45E-03	28	1.95E-04
					Volume	Notch 6	EV	20,389	7	24	8,760		6.47E-04	28	2.31E-05
					Volume	Notch 7	EV	5,949	7	24	8,760		1.89E-04	28	6.74E-06
					Volume	Notch 8	EV	14,767	7	24	8,760		4.68E-04	28	1.67E-05
	F	Adjacent Freight Movements	F1	BNSF Passing Line Haul	Point	Idle	F1T	15,923	7	24	8,760		5.05E-04	88	5.74E-06
					Volume	Dynamic Brake	F1V	83,794	7	24	8,760		2.66E-03	86	3.09E-05
					Volume	Notch 1	F1V	19,156	7	24	8,760		6.07E-04	86	7.06E-06
					Volume	Notch 2	F1V	90,259	7	24	8,760		2.86E-03	86	3.33E-05
					Volume	Notch 3	F1V	139,310	7	24	8,760		4.42E-03	86	5.14E-05
					Volume	Notch 4	F1V	137,260	7	24	8,760		4.35E-03	86	5.06E-05
					Volume	Notch 5	F1V	281,346	7	24	8,760		8.92E-03	86	1.04E-04
					Volume	Notch 6	F1V	752,939	7	24	8,760		2.39E-02	86	2.78E-04
					Volume	Notch 7	F1V	124,390	7	24	8,760		3.94E-03	86	4.59E-05
			F2	Non BNSF Passing Line Haul	Volume	Dynamic Brake	F2V	3,974	7	24	8,760		1.26E-04	86	1.47E-06
					Volume	Notch 1	F2V	20,924	7	24	8,760		6.64E-04	86	7.72E-06
					Volume	Notch 2	F2V	4,782	7	24	8,760		1.52E-04	86	1.76E-06
					Volume	Notch 3	F2V	22,528	7	24	8,760		7.14E-04	86	8.31E-06
					Volume	Notch 4	F2V	34,780	7	24	8,760		1.10E-03	86	1.28E-05
					Volume	Notch 5	F2V	34,265	7	24	8,760		1.09E-03	86	1.26E-05
					Volume	Notch 6	F2V	70,225	7	24	8,760		2.23E-03	86	2.59E-05
					Volume	Notch 7	F2V	187,930	7	24	8,760		5.96E-03	86	6.93E-05
					Volume	Notch 8	F2V	31,047	7	24	8,760		9.84E-04	86	1.14E-05

Table 3-1a

Summary of Emissions and Operating Hours for Modeled DPM Emission Sources[1] BNSF San Bernardino Rail Yard
San Bernardino, California

Emission Source	Activity Category	Activity Category Description	Activity Sub-Category	Activity Sub-Category Description	Modeling Source Type	Operation Mode	Modeling Source Group[2]	Total Emissions (g)	Days of Operation per week[3]	Hours of Operation per day[3]	Hours of Operation per year	Modeled Area (m^2)	Total Emission Rate[4,5] (g/s) or ($g/m^2/s$)	Number of Modeled Sources	Emission Rate Applied to Period-Average Dispersion Factors[6] (g/s)
Locomotives	G	Adjacent Passenger Rail Operations	G1	Metrolink (Passenger Rail)	Point	Idle	G1T	1,629	7	24	8,760		5.17E-05	50	1.03E-06
					Volume	Dynamic Brake	G1V	7,427	7	24	8,760		2.36E-04	50	4.71E-06
					Volume	Notch 1	G1V	1,236	7	24	8,760		3.92E-05	50	7.84E-07
					Volume	Notch 2	G1V	8,953	7	24	8,760		2.84E-04	50	5.68E-06
					Volume	Notch 3	G1V	12,477	7	24	8,760		3.96E-04	50	7.91E-06
					Volume	Notch 4	G1V	11,897	7	24	8,760		3.77E-04	50	7.54E-06
					Volume	Notch 5	G1V	17,959	7	24	8,760		5.69E-04	50	1.14E-05
					Volume	Notch 6	G1V	65,466	7	24	8,760		2.08E-03	50	4.15E-05
					Volume	Notch 7	G1V	12,301	7	24	8,760		3.90E-04	50	7.80E-06
			G2	Amtrak (Passenger Rail)	Point	Idle	G2T	59	7	24	8,760		1.86E-06	35	5.31E-08
					Volume	Dynamic Brake	G2V	267	7	24	8,760		8.47E-06	69	1.23E 07
					Volume	Notch 1	G2V	44	7	24	8,760		1.41E-06	69	2.04E-08
					Volume	Notch 2	G2V	322	7	24	8,760		1.02E-05	69	1.48E-07
					Volume	Notch 3	G2V	449	7	24	8,760		1.42E-05	69	2.06E-07
					Volume	Notch 4	G2V	428	7	24	8,760		1.36E-05	69	1.97E-07
					Volume	Notch 5	G2V	646	7	24	8,760		2.05E-05	69	2.97E-07
					Volume	Notch 6	G2V	2,356	7	24	8,760		7.47E-05	69	1.08E-06
					Volume	Notch 7	G2V	443	7	24	8,760		1.40E-05	69	2.03E-07
Cargo Handling Equipment	H	Cargo Handling Equipment Operations	H1	Lift Machines (Forklift)	Area		H1	522,614	7	24	8,760	223,781	7.41E-08		1.66E-02
			H2	Cranes	Area		H2	877,121	7	24	8,760	133,208	2.09E-07		2.78E-02
			H3	Hostlers (Container Handling Equipment)	Area		H3	1,910,761	7	24	8,760	280,203	2.16E-07		6.06E-02
On Road Container Trucks	I	On Road Container Truck Operations	I1	On Road Container Truck Paths	Volume		I1V	2,295,031	7	24	8,760		7.28E-02	65	1.12E-03
					Area		I1	1,603,329	7	24	8,760	210,721	2.41E-07		5.08E-02
			I2	On Road Refueling Trucks Paths	Volume		I2V	25,912	7	24	8,760		8.22E-04	52	1.58E-05
					Area		I2	2,378	7	24	8,760	9,694	7.78E-09		7.54E-05
On Road Fleet	J	On Road Fleet	J1	BNSF On Road Fleet	Area		J1	14,834	5	12	3,129	32,359	1.45E-08		4.70E-04
			J2	Eagle Fleet	Volume		J2aV	848	5	12	3,129		2.69E-05	42	6.40E-07
					Area		J2b	997	5	12	3,129	247,345	1.28E-10		3.16E-05
				Progressive Fleet	Volume		J2bV	235	5	12	3,129		7.46E-06	131	5.70E-08
					Area		J2a	72	5	12	3,129	227,994	1.00E-11		2.29E-06
Off Road Equipment	K	Other Off Road Equipment	K1a	Boxcar/Freight TRUs	Volume		K1aV	143	7	24	8,760		4.55E-06	15	3.03E-07
					Area		K1a	2,620	7	24	8,760	332,255	2.50E-10		8.31E-05
			K1b	Container/ Trailer TRUs	Area		K1b	3,000,932	7	24	8,760	218,166	4.36E-07		9.52E-02
			K2	Track Maintenance Equipment	Volume		K2V	6,296	5	12	3,129		2.00E-04	52	3.84E-06
					Area		K2	31,610	5	12	3,129	365,165	2.74E-09		1.00E-03
Stationary Sources	L	Stationary Sources	L2	Emergency Generator			L2	84,903			50				

Notes:
1. Stationary Permitted Sources (designated as activity category L) of DPM were not modeled due to negligible emissions and lack of source parameter information for modeling.
2. "Modeling Source Group" corresponds to the modeling source group name in the AERMOD input and output files.
3. "Days of Operation per Week" and "Hours of Operation per Day" indicate general operating schedules. Exact days and hours of operation for each emission activity can be found in the detailed temporal profiles in Appendix A.
4. The "Total Emission Rate" is calculated based on the "Total Emissions" assuming 8760 hours of operation per year. The actual "Hours of Operation per Year" are taken into account in the temporal profiles and are not included in the calculations here to avoid double counting.
5. The "Total Emission Rate" units are "grams per second" for point and volume sources and "grams per meter squared per second" for area sources.
6. The "Emission Rate Applied to Period-Average Dispersion Factors" is the emission rate applied to the modeled period-average dispersion factors for each source group to estimate air concentrations.
For point and volume sources, the "Emission Rate Applied to Period Average Dispersion Factors" is equal to the Total Emission Rate" divided by the "Number of Modeled Emission Sources";
For area sources, the "Emission Rate Applied to Period Average Dispersion Factors" is equal to the Total Emission Rate" multiplied by the modeled area.

Table 3-1b
Summary of Emissions and Operating Hours For Modeled Gasoline Emission Sources BNSF San Bernardino Rail Yard
San Bernardino, California

Activity Subcategory	Activity Subcategory Description	Modeling Source Type	Modeling Source Group[1]	Total Emissions (g)	Days of Operation Per Week[2]	Hours of Operation Per Day[2]	Hours of Operation per year	Total Emission Rate[3,4] (g/s) or (g/m^2/s)	Number of Modeled Sources	Modeled Area (m^2)	Emission Rate Applied to Period-Average Dispersion Factors[5] (g/s)	Iourly Maximum Emission Rate[6] (g/s) or (g/m^2/s)
Gasoline PM (ARB Speciate Profile #400)												
J1	BNSF On Road Fleet	Area	GAS-PM	5,187	5	12	3,129	5.08E-09		32,359	1.64E-04	5.08E-09
J2b	Eagle Fleet	Area		737	5	12	3,129	9.45E-11		247,345	2.34E-05	9.45E-11
J2aV	Eagle Fleet	Volume		627	5	12	3,129	1.99E-05	42		4.73E-07	1.99E-05
J2a	Progressive Fleet	Area		176	5	12	3,129	2.44E-11		227,994	5.57E-06	2.44E-11
J2bV	Progressive Fleet	Volume		572	5	12	3,129	1.82E-05	131		1.39E-07	1.82E-05
K2	Track Maintenance	Volume		5	5	12	3,129	1.56E-07	53		2.95E-09	1.56E-07
		Area		25	5	12	3,129	2.15E-12		365,165	7.84E-07	2.15E-12
TOG Evaporative (ARB Speciate Profile #422)												
J1	BNSF On Road Fleet	Area	TOG-EVAP	214,213	5	12	3,129	2.10E-07		32,359	6.79E-03	2.10E-07
J2b	Eagle Fleet	Area		27,595	5	12	3,129	3.54E-09		247,345	8.75E-04	3.54E-09
J2aV	Eagle Fleet	Volume		23,465	5	12	3,129	7.44E-04	42		1.77E-05	7.44E-04
J2a	Progressive Fleet	Area		2,508	5	12	3,129	3.49E-10		227,994	7.95E-05	3.49E-10
J2bV	Progressive Fleet	Volume		8,179	5	12	3,129	2.59E-04	131		1.98E-06	2.59E-04
K1b	Container/ Trailer RU	Area		14,749,595	7	24	8,760	2.14E-06		218,166	4.68E-01	2.14E-06
K1a	Boxcar/Freight RU	Area		12,875	7	24	8,760	1.23E-09		332,255	4.08E-04	1.23E-09
		Volume		705	7	24	8,760	2.24E-05	15		1.49E-06	2.24E-05
L1	Gasoline Dispensing Facility	Area		132,322	7	24	8,760	3.70E-05		113	4.20E-03	3.70E-05
K2	Track Maintenance	Volume		30	5	12	3,129	9.51E-07	53		1.80E-08	9.51E-07
		Area		151	5	12	3,129	1.31E-11		365,165	4.78E-06	1.31E-11
TOG Exhaust (ARB Speciate Profile #2105)												
J1	BNSF On Road Fleet	Area	TOG-EX	387,590	5	12	3,129	3.80E-07		32,359	1.23E-02	3.80E-07
J2b	Eagle Fleet	Area		62,588	5	12	3,129	8.02E-09		247,345	1.98E-03	8.02E-09
J2aV	Eagle Fleet	Volume		53,220	5	12	3,129	1.69E-03	42		4.02E-05	1.69E-03
J2a	Progressive Fleet	Area		3,138	5	12	3,129	4.36E-10		227,994	9.95E-05	4.36E-10
J2bV	Progressive Fleet	Volume		10,234	5	12	3,129	3.25E-04	131		2.48E-06	3.25E-04
K2	Track Maintenance	Volume		170	5	12	3,129	5.41E-06	53		1.02E-07	5.41E-06
		Area		856	5	12	3,129	7.43E-11		365,165	2.71E-05	7.43E-11

Notes:
1. "Modeling Source Group" corresponds to the modeling source group name in the AERMOD input and output files.
2. "Days of Operation per Week" and "Hours of Operation per Day" indicate general operating schedules. Exact days and hours of operation for each emission activity can be found in the detailed temporal profiles in Appendix A.
3. The "Total Emission Rate" is calculated based on the "Total Emissions" assuming 8760 hours of operation per year. The actual "Hours of Operation per Year" are taken into account in the temporal profiles and are not included in the calculations here to avoid double counting.
4. The "Total Emission Rate" units are "grams per second" for point and volume sources and "grams per meter squared per second" for area sources.
5. The "Emission Rate Applied to Period-Average Dispersion Factors" is the emission rate applied to the modeled period-average dispersion factors for each source group to estimate air concentrations. For point and volu sources, the "Emission Rate Applied to Period-Average Dispersion Factors" is equal to the Total Emission Rate" divided by the "Number of Modeled Emission Sources"; For area sources, the "Emission Rate Applied to Period-Average Dispersion Factors" is equal to the Total Emission Rate" multiplied by the modeled area.
6. The "Hourly Maximum Emission Rate" is the emission rate used in the air dispersion model. For point and volume sources, the "Hourly Maximum Emission Rate" is equal to the "Emission Rate Applied to Period-Average Dispersion Factors"; For area sources, the "Hourly Maximum Emission Rate" is equal to the "Total Emission Rate".

Table 3-2
Summary of Activity Category Total Annual DPM and TOG Emissions at the Facility
BNSF San Bernardino Rail Yard
San Bernardino, California

Activity Category	Activity Category Description	Diesel			Gasoline								
		PM Emissions			PM Emissions			TOG Evaporative Emissions			TOG Exhaust Emissions		
		Grams	Metric Tons	Percentage (%)	Grams	Metric Tons	Percentage (%)	Grams	Metric Tons	Percentage (%)	Grams	Metric Tons	Percentage (%)
A	Basic Services	354,369	0.35	1.8%									
C	Crew Change	171,485	0.17	0.9%									
D	Locomotive Switching	3,681,311	3.68	18.5%									
E	Arriving Departing Line Haul	3,146,037	3.15	15.8%									
F	Adjacent Freight Movements	2,054,830	2.05	10.3%									
G	Adjacent Passenger Rail Operations	144,360	0.14	0.7%									
H	Cargo Handling Equipment	3,310,496	3.31	16.6%									
I	On Road Container Trucks	3,926,651	3.93	19.7%									
J	On Road Fleet Vehicles	16,987	0.02	0.1%	7,299	7.30E-03	99.6%	275,962	2.76E-01	1.8%	516,769	5.17E-01	99.8%
K	Off Road Equipment	3,041,601	3.04	15.3%	30	2.97E-05	0.4%	14,763,356	1.48E+01	97.3%	1,026	1.03E-03	0.2%
L	Emergency Generators[1]	84,903	0.04	0.2%									
	Gasoline Dispensing Facility							132,322	1.32E-01	0.9%			
	TOTAL	19,933,029	19.89	100%	7,329	7.33E-03	100%	15,171,639	1.52E+01	100%	517,796	5.18E-01	100%

Notes:
1 Stationary Permitted Sources (designated as activity category L) of DPM were not modeled due to negligible emissions and lack of source parameter information for modeling.

Table 4-1
Fleet-Average Source Parameters for Locomotive Activities
BNSF San Bernardino Rail Yard
San Bernardino, California

									Day		Night	
Activity Subcategory	**Activity Subcategory Description**	**Modeling Source Type**	**Operation Mode**	**Stack Ieight (m)**	**Exit Temperature (K)**	**Exit Velocity (m/s)**	**Exit Diameter (m)**	**Initial Lateral Dimension (m)**	**Release Ieight (m)**	**Initial Vertical Dimension (m)**	**Release Ieight (m)**	**Initial Vertical Dimension (m)**
A2	Idling While Refueling	Point	Idle	4.52	389.92	2.96	0.60					
C	Crew Change	Point	Idle	4.52	389.92	2.96	0.60					
		Volume	Dynamic Brake					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 1					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 2					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 3					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 4					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 5					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 6					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 7					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 8					4.19- 34.88	5.45	1.27	13.66	3.18
D	Switching	Point	Idle	4.52	361.60	15.56	0.29					
		Volume	Dynamic Brake					4.19- 34.88	73.15	17.01	49.78	11.58
		Volume	Notch 1					4.19- 34.88	73.15	17.01	49.78	11.58
		Volume	Notch 2					4.19- 34.88	73.15	17.01	49.78	11.58
		Volume	Notch 3					4.19- 34.88	73.15	17.01	49.78	11.58
		Volume	Notch 4					4.19- 34.88	73.15	17.01	49.78	11.58
		Volume	Notch 5					4.19- 34.88	73.15	17.01	49.78	11.58
		Volume	Notch 6					4.19- 34.88	73.15	17.01	49.78	11.58
		Volume	Notch 7					4.19- 34.88	73.15	17.01	49.78	11.58
		Volume	Notch 8					4.19- 34.88	73.15	17.01	49.78	11.58
E	Arriving Departing Line Haul	Point	Idle	4.52	389.92	2.96	0.60					
		Volume	Dynamic Brake					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 1					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 2					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 3					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 4					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 5					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 6					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 7					4.19- 34.88	5.45	1.27	13.66	3.18
		Volume	Notch 8					4.19- 34.88	5.45	1.27	13.66	3.18
F1	BNSF Passing Line Haul	Point	Idle	4.52	389.92	2.96	0.60					
		Volume	Dynamic Brake					1.00- 5.02	10.84	2.52	19.01	4 42
		Volume	Notch 1					1.00- 5.02	10.84	2.52	19.01	4 42
		Volume	Notch 2					1.00- 5.02	10.84	2.52	19.01	4 42
		Volume	Notch 3					1.00- 5.02	10.84	2.52	19.01	4 42
		Volume	Notch 4					1.00- 5.02	10.84	2.52	19.01	4 42
		Volume	Notch 5					1.00- 5.02	10.84	2.52	19.01	4 42
		Volume	Notch 6					1.00- 5.02	10.84	2.52	19 01	4 42
		Volume	Notch 7					1.00- 5.02	10.84	2.52	19.01	4 42

Table 4-1
Fleet-Average Source Parameters for Locomotive Activities
BNSF San Bernardino Rail Yard
San Bernardino, California

									Day		Night	
Activity Subcategory	**Activity Subcategory Description**	**Modeling Source Type**	**Operation Mode**	**Stack Ieight (m)**	**Exit Temperatur e (K)**	**Exit Velocity (m/s)**	**Exit Diameter (m)**	**Initial Lateral Dimension (m)**	**Release Ieight (m)**	**Initial Vertical Dimensio n (m)**	**Release Ieight (m)**	**Initial Vertical Dimensio n (m)**
F2	Non BNSF Passing Line Haul	Volume	Dynamic Brake					1.00- 5.02	13.54	3.15	20 36	4.74
		Volume	Notch 1					1.00- 5.02	13.54	3.15	20 36	4.74
		Volume	Notch 2					1.00- 5.02	13.54	3.15	20 36	4.74
		Volume	Notch 3					1.00- 5.02	13.54	3.15	20 36	4.74
		Volume	Notch 4					1.00- 5.02	13.54	3.15	20 36	4.74
		Volume	Notch 5					1.00- 5.02	13.54	3.15	20 36	4.74
		Volume	Notch 6					1.00- 5.02	13.54	3.15	20 36	4.74
		Volume	Notch 7					1.00- 5.02	13.54	3.15	20 36	4.74
		Volume	Notch 8					1.00- 5.02	13.54	3.15	20 36	4.74
G1	Metrolink (Passenger Rail)	Point	Idle	4.52	373.22	5.48	0.62					
		Volume	Dynamic Brake					0.50	8.85	2.06	17.51	4.07
		Volume	Notch 1					0.50	8.85	2.06	17.51	4.07
		Volume	Notch 2					0.50	8.85	2.06	17.51	4.07
		Volume	Notch 3					0.50	8.85	2.06	17.51	4.07
		Volume	Notch 4					0.50	8.85	2.06	17.51	4.07
		Volume	Notch 5					0.50	8.85	2.06	17.51	4.07
		Volume	Notch 6					0.50	8.85	2.06	17.51	4.07
		Volume	Notch 7					0.50	8.85	2.06	17.51	4.07
G2	Amtrak (Passenger Rail)	Point	Idle	4.52	373.22	5.48	0.62					
		Volume	Dynamic Brake					0.50- 2.01	8.85	2.06	17.51	4.07
		Volume	Notch 1					0.50- 2.01	8.85	2.06	17.51	4.07
		Volume	Notch 2					0.50- 2.01	8.85	2.06	17.51	4.07
		Volume	Notch 3					0.50- 2.01	8.85	2.06	17.51	4.07
		Volume	Notch 4					0.50- 2.01	8.85	2.06	17.51	4.07
		Volume	Notch 5					0.50- 2.01	8.85	2.06	17.51	4.07
		Volume	Notch 6					0.50- 2.01	8.85	2.06	17.51	4.07
		Volume	Notch 7					0.50- 2.01	8.85	2.06	17.51	4.07

Table 4-2

Plume Rise Adjustments for Locomotive Movement Sources[1]
BNSF San Bernardino Rail Yard
San Bernardino, California

Activity Subcategory	Activity Subcategory Description	Modeled Notch Setting[2]	Locomotive Speed (mph)	Locomotive Speed (m/s)	Modeled Locomotive Type	Plume Height[3] (m)			Initial Vertical Dimension (m)		
						Stability D	Stability F	Adjusted F[4]	Stability D	Stability F	Adjusted F[4]
C	Crew Change	3	30	13.41	LH	5.45	26.23	13.66	1.27	6.10	3.18
D	Switching	8	5	2.24	LH	73.15	49.78		17.01	11.58	
E	Arriving Departing Line Haul	3	30	13.41	LH	5.45	26.23	13.66	1.27	6.10	3.18
F	BNSF Passing Line Haul	6	30	13.41	LH	10.84	38.94	19.01	2.52	9.06	4 42
	Non BNSF Passing Line Haul	7	30	13.41	LH	13.54	42.16	20 36	3.15	9.80	4.74
G	Metrolink (Passenger Rail)	6	30	13.41	LH	8.85	35.39	17.51	2.06	8.23	4.07
	Amtrak (Passenger Rail)	6	30	13.41	LH	8.85	35.39	17.51	2.06	8.23	4.07

Notes:
1. Plume rise calculated using USEPA's SCREEN3 model using methodology in ARB's Roseville Study (ARB 2004)
2. Due to sensitivity of plume rise to wind speed and locomotive speed, plume rise adjustments calculated for only one notch setting per source subactivity. For source subactivities with multiple notch settings, the source parameters for the notch setting with the greatest percentage of activity emissions were selected
3. Plume Height = physical height of locomotive plus plume rise
4. The maximum wind speed for stability category F in SCREEN3 is 4.0 m/s. For locomotive speeds (i e , effective wind speeds) greater than 4.0 m/s, the plume rise for stability category F was adjusted according to the methodology in the ARB Roseville Study (ARB 2004): adjusted plume rise = plume rise x (1/locomotive speed)^(1/3)

Source:
1 Air Resources Board (ARB) 2004 Roseville Rail Yard Study October 2004

Table 4-3
Source Parameters for Cargo Iandling Equipment, On-Road Container Trucks, and Off-Road Equipment
BNSF San Bernardino Rail Yard
San Bernardino, California

Activity Subcategory	Activity Subcategory Description	Modeling Source Type	Day		Night	
			Release Height[1] (m)	Initial Vertical Dimension[2] (m)	Release Height[1] (m)	Initial Vertical Dimension[2] (m)
H1	Cargo Handling: Lift Machines (Forklift)	Area	3.90	0.91	3.90	0.91
H2	Cargo Handling: Cranes	Area	3.90	0.91	3.90	0.91
H3	Cargo Handling: Hostlers	Area	0.60	0.14	0.60	0.14
I1	On Road Container Truck Paths	Volume	4.00	0.93	6.00	1.40
		Area	4.00	0.93	6.00	1.40
I2	On Road Refueling Trucks Paths	Volume	4.00	0.93	6.00	1.40
		Area	4.00	0.93	6.00	1.40
K1a	Off Road: Boxcar/Freight TRUs	Volume	1.00	0.23	1.00	0.23
		Area	1.00	0.23	1.00	0.23
K1b	Off Road: Container/ Trailer TRUs	Area	1.00	0.23	1.00	0.23
K2	Off Road: Track Maintenance Equipment	Volume	5.45	1.27	5.45	1.27
		Area	5.45	1.27	5.45	1.27

Notes:

1. Assumed release height for track maintenance equipment equal to the lowest plume height from plume rise adjusments for locomotive sources assumed release height for portable engines equal to 0.6 meter based on ARB Risk Reduction Plan (ARB 2000) and recommendations from ARB staff.
2. Initial vertical dimension calculated as release height divided by 4.3 based on USEPA guidance (USEPA 2004) for volume sources not on or adjacent to a building.

Sources:

1 Air Resources Board (ARB) 2000 Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel Fueled Engines and Vehicles. Appendix VII: Risk Characterization Scenarios. October.

2 United States Environmental Protection Agency (USEPA) 2004 User's Guide for the AMS/EPA Regulatory Model - AERMOD. Office of Air Quality Planning and Standards. Emissions Monitoring and Analysis Division. Research Triangle Park, North Carolina. EPA-454/B-03-001. September.

Table 4-4
Source Parameters for On-Road Fleet
BNSF San Bernardino Rail Yard
San Bernardino, California

Activity Subcategory	Activity Subcategory Description	Modeling Source Type[1]	Initial Lateral Dimension (m)	Release Height[2] (m)	Initial Vertical Dimension (m)
J1	BNSF On Road Fleet	Area		0.60	0.14
J2a	Eagle Fleet	Volume	1.64	0.60	0.14
J2b		Area		0.60	0.14
J2b	Progressive Fleet	Volume	1.64	0.60	0.14
J2a		Area		0.60	0.14

Notes:
1. On road fleet modeled as area sources (for travel in larger areas without distinguishable paths).
2. Release height based on ARB Risk Reduction Plan (ARB 2000) and recommendations from ARB staff.

Source:
1. Air Resources Board (ARB). 2000. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles. Appendix VII: Risk Characterization Scenarios. October.

Table 4-5
Source Parameters for Permitted Stationary Source
BNSF San Bernardino Rail Yard
San Bernardino, California

Activity Subcategory	Activity Subcategory Description	Modeling Source Type	Release Height[1] (m)	Initial Vertical Dimension (m)
L1	Gasoline Dispensing Facility	Area	0	0

Notes:
1 Release height for the Gasoline Dispensing Facility conservatively assumed to equal zero.

Table 4-6
Sector-Specific Surface Roughness, Bowen Ratio, and Albedo
BNSF San Bernardino Rail Yard
San Bernardino, California

Month	Sector No.	2005			2006		
		Albedo	Bowen Ratio	Surface Roughness	Albedo	Bowen Ratio	Surface Roughness
Jan	1	0.18	1.79	0.81	0.18	3 62	0.81
Feb		0.15	0.88	0.82	0.15	0.88	0.82
Mar		0.15	0.88	0.82	0.15	0.88	0.82
Apr		0.16	1.76	0.83	0.16	1.76	0.83
May		0.16	1.76	0.83	0.16	1.76	0.83
Jun		0.16	1.76	0.83	0.16	1.76	0.83
Jul		0.17	0.89	0.82	0.17	3.60	0.82
Aug		0.17	0.89	0.82	0.17	3.60	0.82
Sep		0.17	0.89	0.82	0.17	3.60	0.82
Oct		0.17	0.89	0.82	0.17	3.60	0.82
Nov		0.18	1.79	0.81	0.18	3 62	0.81
Dec		0.18	1.79	0.81	0.18	3 62	0.81
Jan	2	0.18	1.98	0.97	0.18	3.95	0.97
Feb		0.14	0.99	0.97	0.14	0.99	0.97
Mar		0.14	0.99	0.97	0.14	0.99	0.97
Apr		0.16	1.97	0.97	0.16	1.97	0.97
May		0.16	1.97	0.97	0.16	1.97	0.97
Jun		0.16	1.97	0.97	0.16	1.97	0.97
Jul		0.17	0.99	0.97	0.17	3.95	0.97
Aug		0.17	0.99	0.97	0.17	3.95	0.97
Sep		0.17	0.99	0.97	0.17	3.95	0.97
Oct		0.17	0.99	0.97	0.17	3.95	0.97
Nov		0.18	1.98	0.97	0.18	3.95	0.97
Dec		0.18	1.98	0.97	0.18	3.95	0.97
Jan	3	0.18	1.88	0.84	0.18	3.76	0.84
Feb		0.15	0.93	0.84	0.15	0.93	0.84
Mar		0.15	0.93	0.84	0.15	0.93	0.84
Apr		0.17	1 83	0.85	0.17	1 83	0.85
May		0.17	1 83	0.85	0.17	1 83	0.85
Jun		0.17	1 83	0.85	0.17	1 83	0.85
Jul		0.17	0.92	0.84	0.17	3 73	0.84
Aug		0.17	0.92	0.84	0.17	3 73	0.84
Sep		0.17	0.92	0.84	0.17	3 73	0.84
Oct		0.17	0.92	0.84	0.17	3 73	0.84
Nov		0.18	1.88	0.84	0.18	3.76	0.84
Dec		0.18	1.88	0.84	0.18	3.76	0.84

Table 4-6
Sector-Specific Surface Roughness, Bowen Ratio, and Albedo
BNSF San Bernardino Rail Yard
San Bernardino, California

Month	Sector No.	2005			2006		
		Albedo	Bowen Ratio	Surface Roughness	Albedo	Bowen Ratio	Surface Roughness
Jan	4	0.18	1.98	0.98	0.18	3.96	0.98
Feb		0.14	0.99	0.98	0.14	0.99	0.98
Mar		0.14	0.99	0.98	0.14	0.99	0.98
Apr		0.16	1.98	0.98	0.16	1.98	0.98
May		0.16	1.98	0.98	0.16	1.98	0.98
Jun		0.16	1.98	0.98	0.16	1.98	0.98
Jul		0.17	0.99	0.98	0.17	3.96	0.98
Aug		0.17	0.99	0.98	0.17	3.96	0.98
Sep		0.17	0.99	0.98	0.17	3.96	0.98
Oct		0.17	0.99	0.98	0.17	3.96	0.98
Nov		0.18	1.98	0.98	0.18	3.96	0.98
Dec		0.18	1.98	0.98	0.18	3.96	0.98

Table 4-7
Approximate Dimensions of Buildings at the Facility
BNSF San Bernardino Rail Yard
San Bernardino, California

Building/ Structure ID	Building Name	UTM X (m)	UTM Y (m)	Approximate Footprint Dimensions[1] (m)	Height[2] (m)
1	BNSF Administration Office	469886.38	3773892.57	24 m x 52 m	6.68
2	Eagle Tractor Repair	469733.65	3773904.51	48 m x 33 m	6.70
3	Car Shop Building	469990.05	3773156.49	33 m x 125 m	6.70
4	Structures Equipment Storage	470673.30	3773533.37	14 m x 78 m	5 17
5	West Building	470670.39	3773452.24	14 m x 50 m	5.00
6	East Building	470694.67	3773448.84	15 m x 23 m	5.90
7	Container Storage Building	469251.43	3773674.98	53 m x 37 m	8.23
8	Eagle Equipment Repair	471086.71	3774021.24	23 m x 60 m	6.95
9	North Building	471082.74	3774094.48	11 m x 17 m	3.59
10	BNSF Vapor Recovery	471345.25	3774016.83	22 m x 22 m	7.57
11	Tower	471073.51	3774059.54	4 m (side of hexagon)	25 30

Notes:
1. Approximate footprint dimensions estimated based on aerial photograph of facility.
2. Building heights provided by BNSF personnel.

Table 4-8
Population Density Within Three Kilometers of the Facility
BNSF San Bernardino Rail Yard
San Bernardino, CA

Location	Land Area Within 3 km (m^2)	Water Area Within 3 km (m^2)	Yard Area (m^2)	Total Population Within 3 km	Population Density (people/km^2)
San Bernardino, C	64,584,347	1,026,029	1,287,468	128,014	1,990
USE URBAN BOUNDARY LAYER?					YES

Table 4-9
Locations of Sensitive Receptors Within One Mile of the Facility
BNSF San Bernardino Rail Yard
San Bernardino, CA

Facility	Address	City	Type	UTM X	UTM Y
St. John's Lutheran Child Care Center	820 N La Cadena Dr.	Colton	Childcare Center	470217.3	3770379.4
CJUSD/Grant[1]	550 W. Olive St.	Colton	Childcare Center	469552.9	3770809.7
Grant (Ulysses) Elementary [1]	550 W. Olive St.	Colton	Public School	469552.9	3770809.7
CJUSD/Lincoln[1]	444 E. Olive St.	Colton	Childcare Center	470676.2	3770807.1
Lincoln (Abraham) Elementary [1]	444 E. Olive St.	Colton	Public School	470676.2	3770807.1
CJUSD/Alice Birney[1]	1050 E. Olive Pl.	Colton	Childcare Center	471294.1	3770905.7
Birney (Alice) Elementary [1]	1050 E. Olive Pl.	Colton	Public School	471294.1	3770905.7
Colton Middle	670 W. Laurel St.	Colton	Public School	469354.7	3771238.7
SBCUSD-Urbita Preschool [1]	771 S. J St.	San Bernardino	Childcare Center	471836.7	3771676.4
Urbita Elementary[1]	771 S. J St.	San Bernardino	Public School	471836.7	3771676.4
CJUSD/McKinley[1]	600 W. Johnston St.	Colton	Childcare Center	469505.9	3772026.1
McKinley (William) Elementary[1]	600 W. Johnston St.	Colton	Public School	469505.9	3772026.1
S C Frazee	11240 West Mill St.	San Bernardino	Hospital	471311.3	3772434.2
Sierra Vista State Preschool	2300 North Rancho	Colton	Childcare Center	469246.3	3772443.6
Richardson Prep HT	455 S. K St.	San Bernardino	Public School	471637.9	3772485.9
Kelley Elementary	380 S. Meridian Ave.	Rialto	Public School	467837.4	3772685.3
San Bernardino City School District - Alldred Child	303 S. K St.	San Bernardino	Childcare Center	471644.5	3772894 4
SBCUSD Lytle Creek Preschool[1]	275 S. K St.	San Bernardino	Childcare Center	471642.4	3773049.3
Lytle Creek Elementary[1]	275 S. K St.	San Bernardino	Public School	471642.4	3773049.3
Civic Circle Preschool	265 N. D St.	San Bernardino	Childcare Center	473091.9	3773723.1
Trinity Hospice	290 N. D St., Ste. 803	San Bernardino	Hospital	473069.1	3773774.2
Kindercare Learning Center	304 N. Pepper Ave	Rialto	Childcare Center	467434.2	3773853.3
OADP - Perinatal Substance Abuse Treatment Services	850 E Foothill Blvd, Ste. A	Rialto	Childcare Center	467248.4	3774033.9
St. Grace Hospice Inc.	350 W. Fifth St.	San Bernardino	Hospital	473195.8	3774223.4
Juvenile Hall/Community [1]	601 N. E St.	San Bernardino	Public School	472897.9	3774421.3
Special Education[1]	601 N. E St.	San Bernardino	Public School	472897.9	3774421.3
Kid's Turf Daycare	744 W. Sixth St.	San Bernardino	Childcare Center	472379.6	3774431.6
Careline Health Services	639 N. Arrowhead Ave.	San Bernardino	Hospital	473302.5	3774489.5
All American Hospice	669 N. Arrowhead Ave.	San Bernardino	Hospital	473302.0	3774546.7
Ramona-Alessandro Elementary	670 Ramona Ave.	San Bernardino	Public School	470364.8	3774563.2
Casa Ramona Child Development Center	1524 W. Seventh St.	San Bernardino	Childcare Center	470448.2	3774633.1
Whitney Young Family Health Clinic	1755 W. Maple	San Bernardino	Hospital	470017.2	3774881.0
PSD/San Bernardino West Head Start	901 N. Wilson	San Bernardino	Childcare Center	470072.7	3775046.4

Table 4-9
Locations of Sensitive Receptors Within One Mile of the Facility
BNSF San Bernardino Rail Yard
San Bernardino, CA

Facility	Address	City	Type	UTM X	UTM Y
PSD/Boys And Girls Club Head Start Center[1]	1180 W. Ninth St.	San Bernardino	Childcare Center	471245.5	3775063.1
Boys And Girls Club Academy [1]	1180 W. Ninth St.	San Bernardino	Public School	471245.5	3775063.1
SBCUSD Mt. Vernon Elementary [1]	1271 W. Tenth St.	San Bernardino	Childcare Center	471168.6	3775251.8
Mt Vernon Elementary[1]	1271 W. Tenth St.	San Bernardino	Public School	471168.6	3775251.8
Samaritan Counseling Clinic	1024 N. G St.	San Bernardino	Hospital	472458.9	3775297.2
Eagle Valley	1053 N. D St.	San Bernardino	Private School	473098.2	3775335.7
Horton's Little Angels Childcare Center	536 W. 11th St.	San Bernardino	Childcare Center	472837.3	3775460.2

Note:
1. Although addresses are identical, buildings are modeled as separate sources because they are different service types.

Sources:
Locations of sensitive receptors were obtained from the following databases:
a. California Department of Education, California School Directory (http://www.cde.ca.gov/re/sd/)
b The Automated Licensing Information and Report Tracking System (Hospitals and Licensed Care Facilities) (http://alirts.oshpd.ca.gov/AdvSearch.asp)
c. Yellow pages (http://yp.yahoo com)
d. Community Care Licensing Division, State of California (http://www.ccld.ca.gov/docs/ccld_search/ccld_search.asp)

Figure 2-1: General Facility Location
BNSF San Bernardino Rail Yard
San Bernardino, California

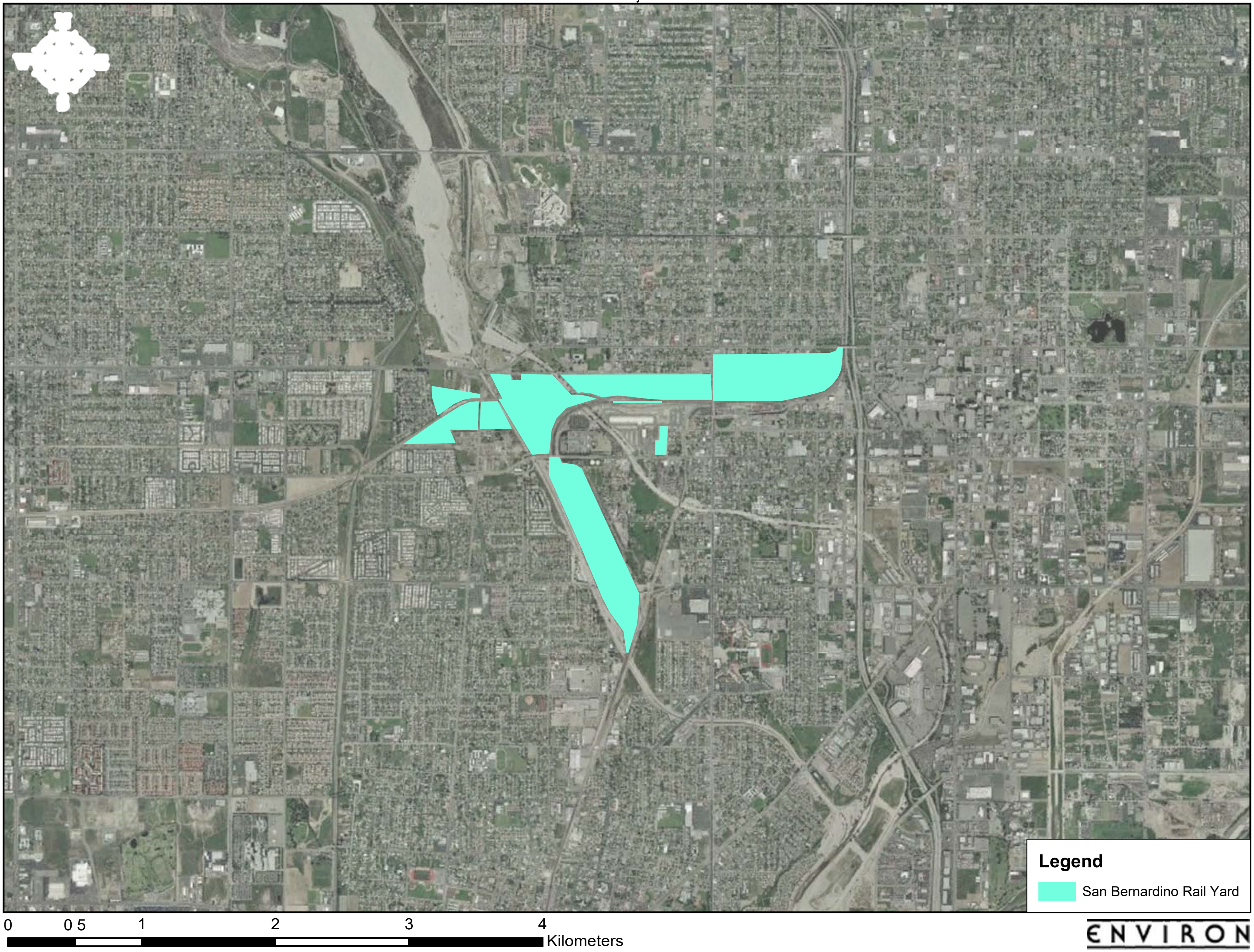
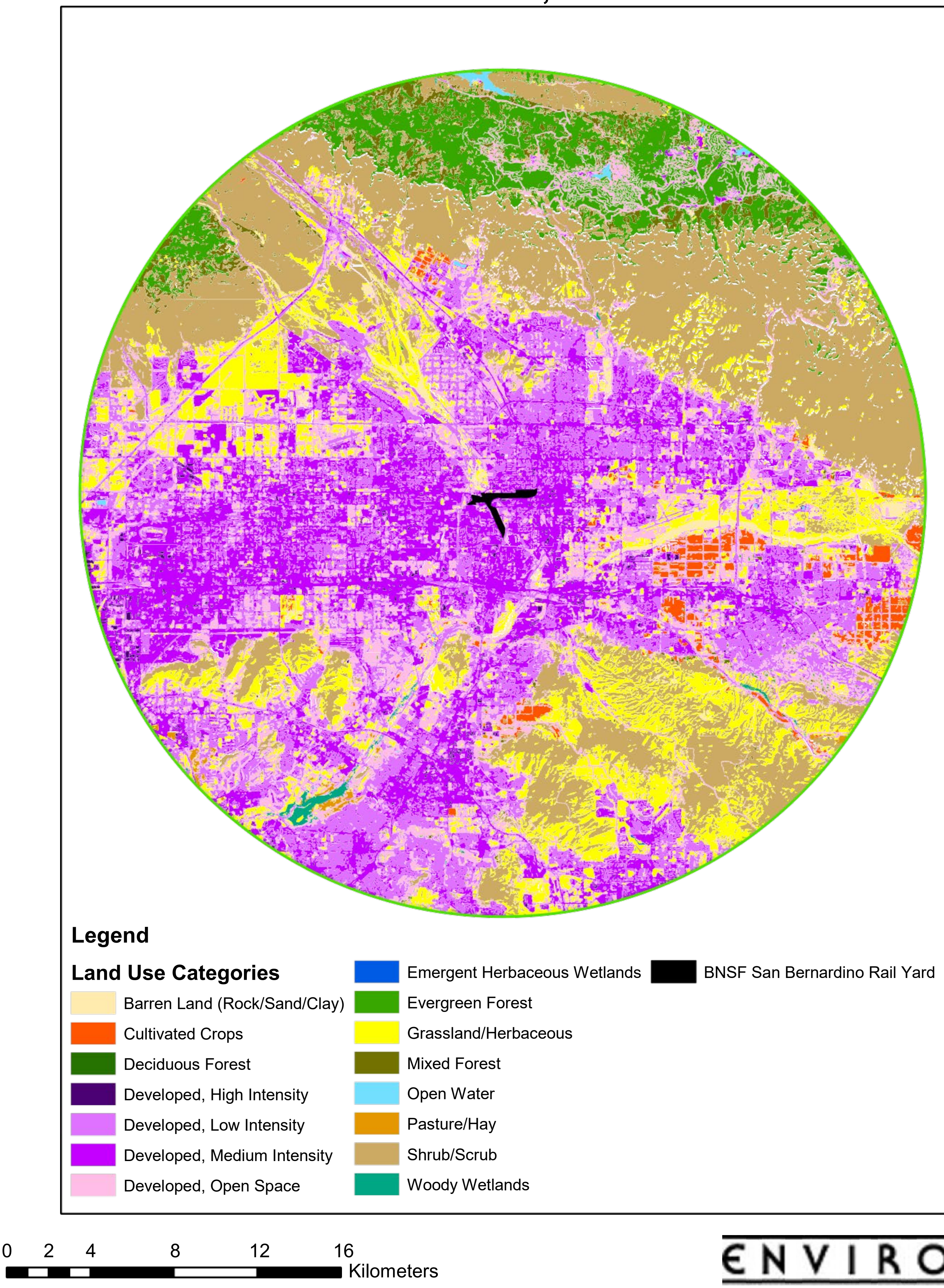
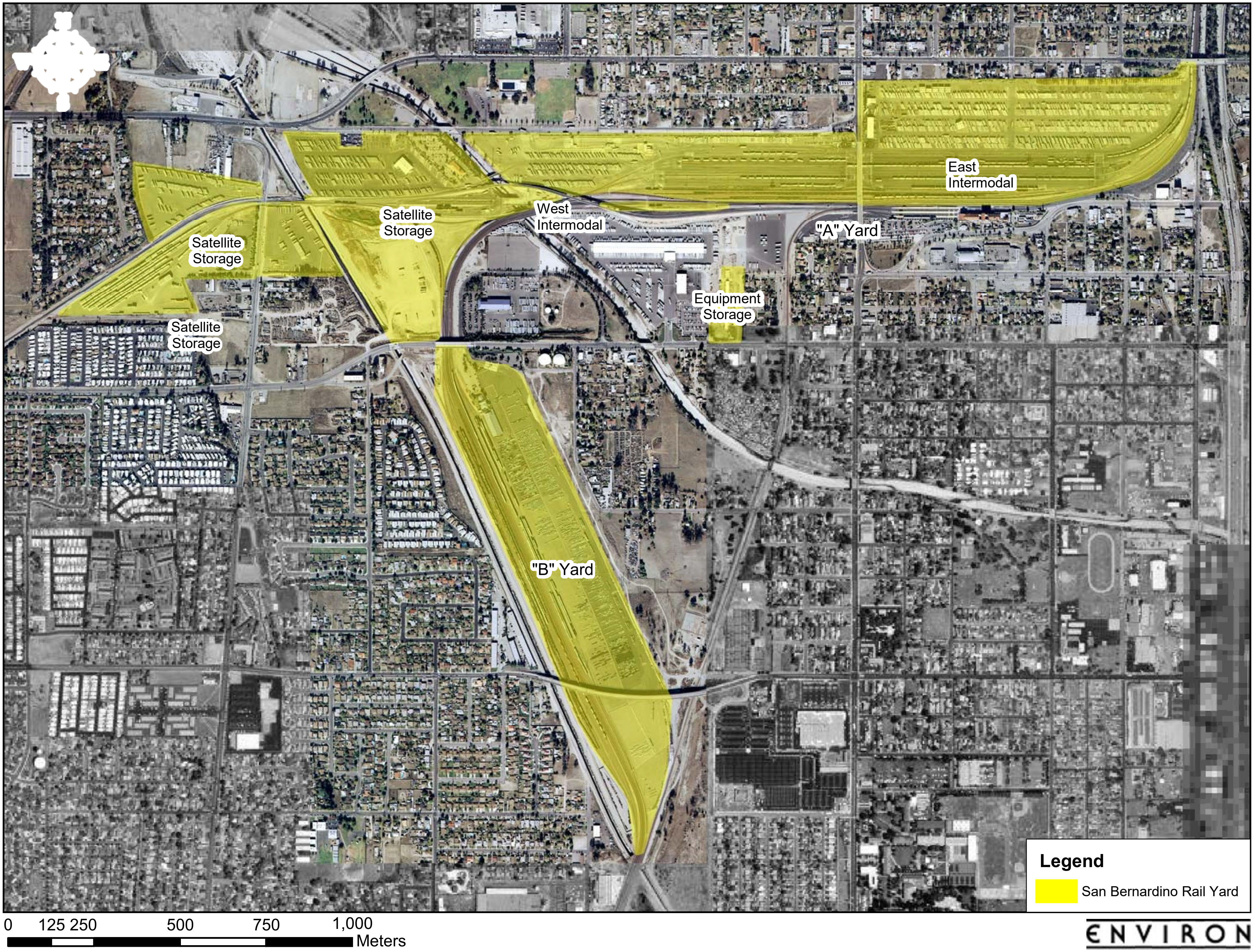


Figure 2-2: Land Use Within Twenty Kilometers of Facility
BNSF San Bernardino Rail Yard
San Bernardino, California



ENVIRON

Figure 2-3: General Location of Operational Areas at the Facility
BNSF San Bernardino Rail Yard
San Bernardino, California



ENVIRON

Figure 2-4: Stationary and Movement Locomotive Activities - Switching and Idling while Refueling
BNSF San Bernardino Rail Yard
San Bernardino, California

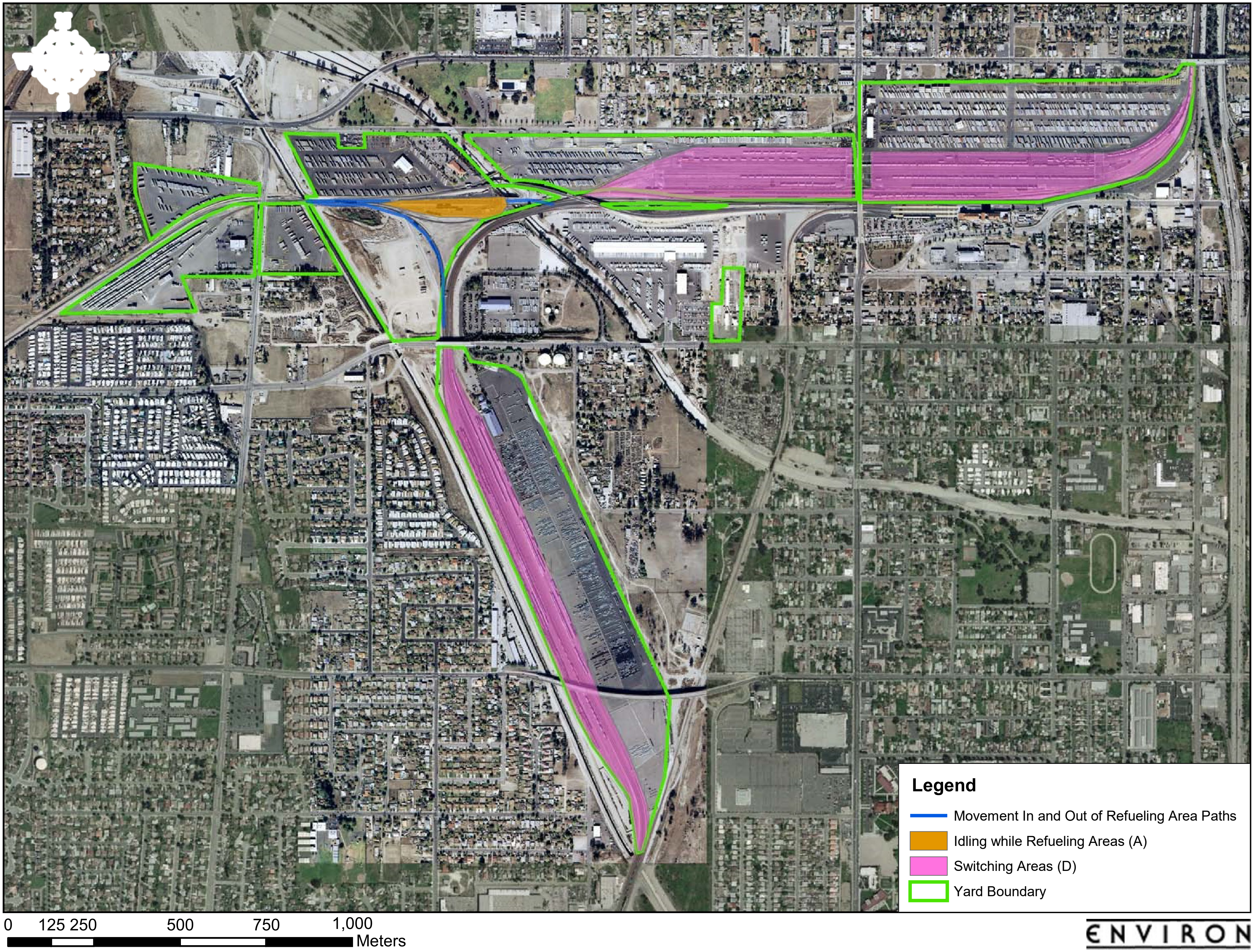


Figure 2-5: Off-Road Equipment - Transportation Refrigeration Units ("A" Yard)
BNSF San Bernardino Rail Yard
San Bernardino, California

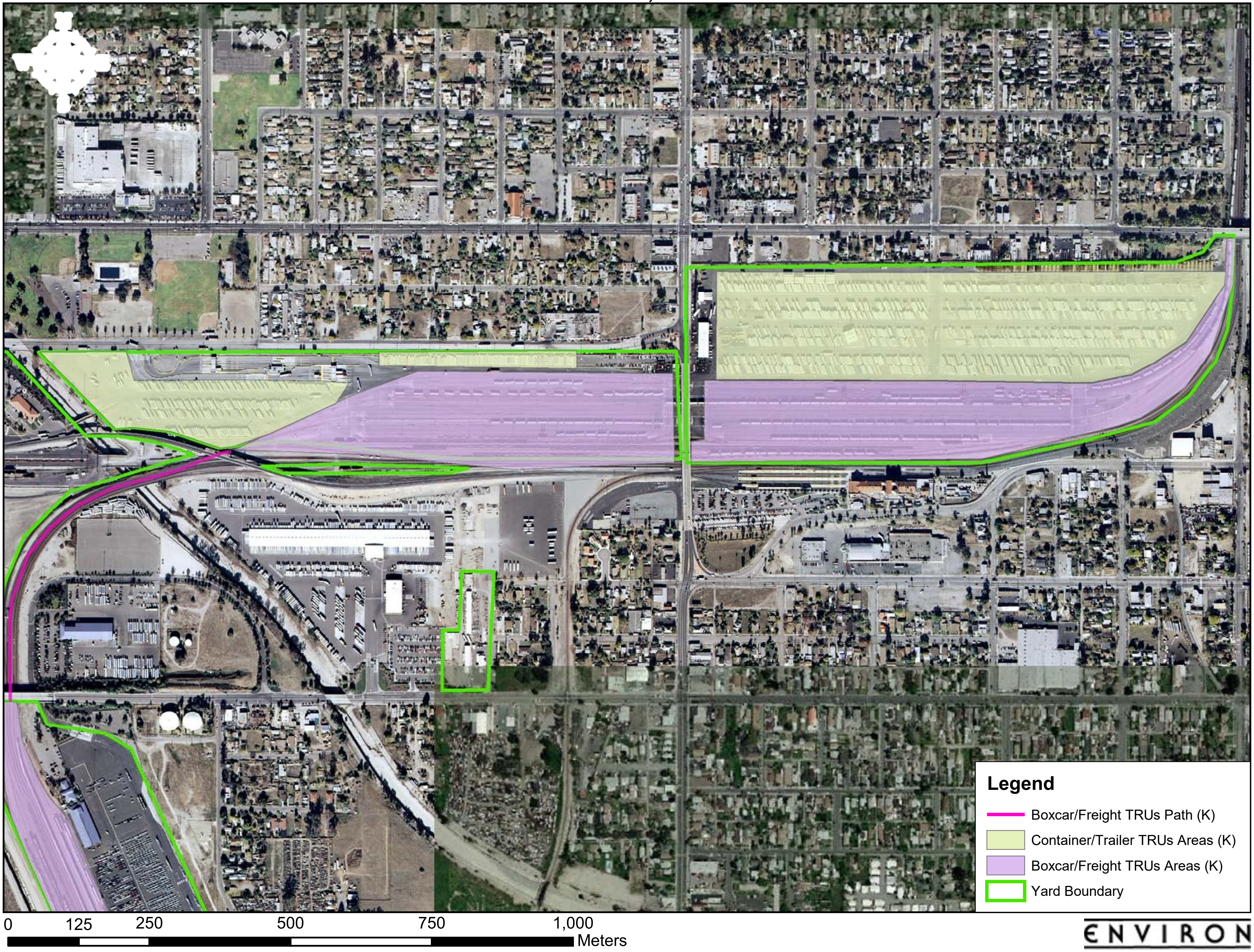


Figure 2-6: Off-Road Equipment - Track Maintenance Equipment
BNSF San Bernardino Rail Yard
San Bernardino, California

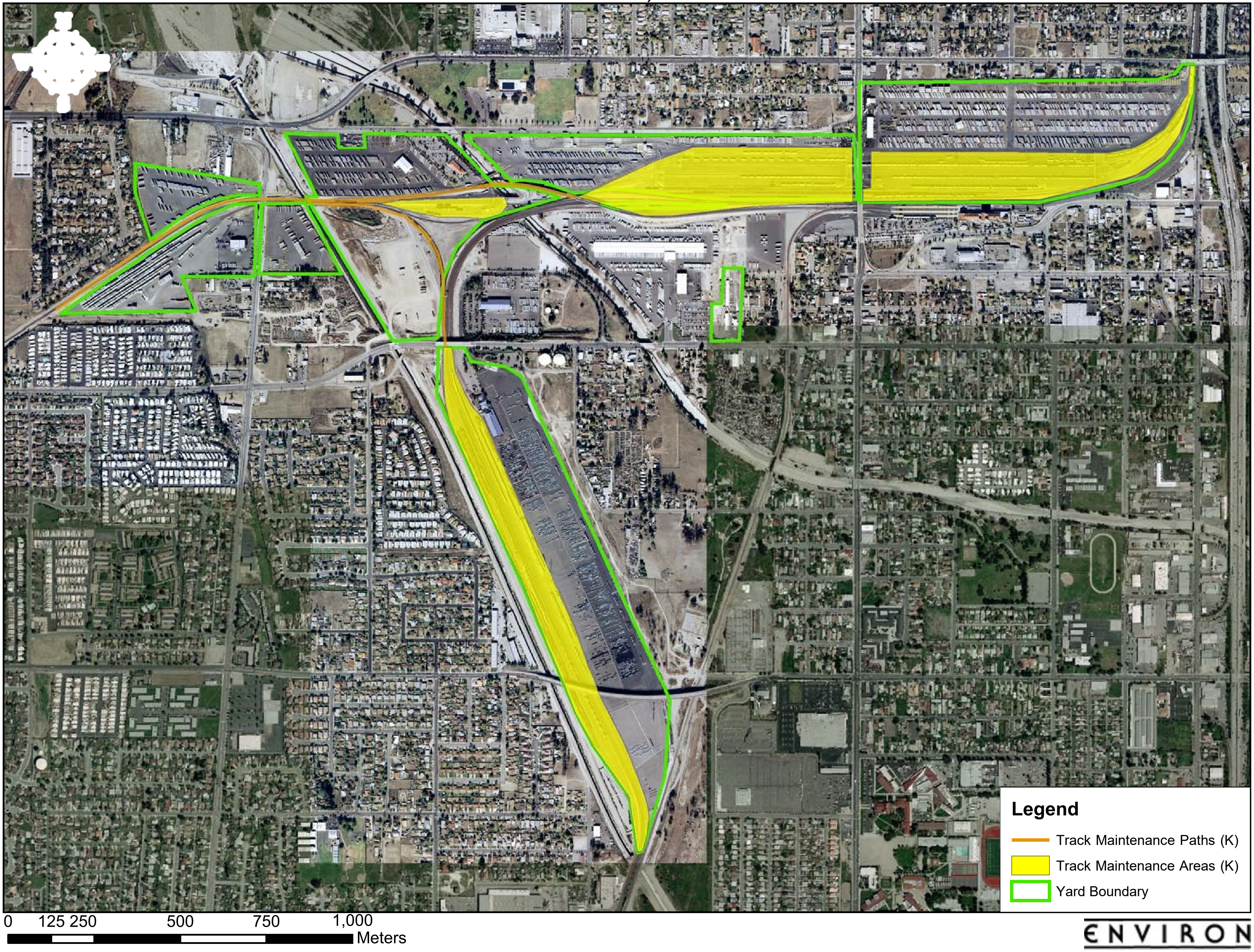


Figure 2-7: Stationary and Movement Locomotive Activities - Arriving-Departing Line Haul and Crew Change
BNSF San Bernardino Rail Yard
San Bernardino, California

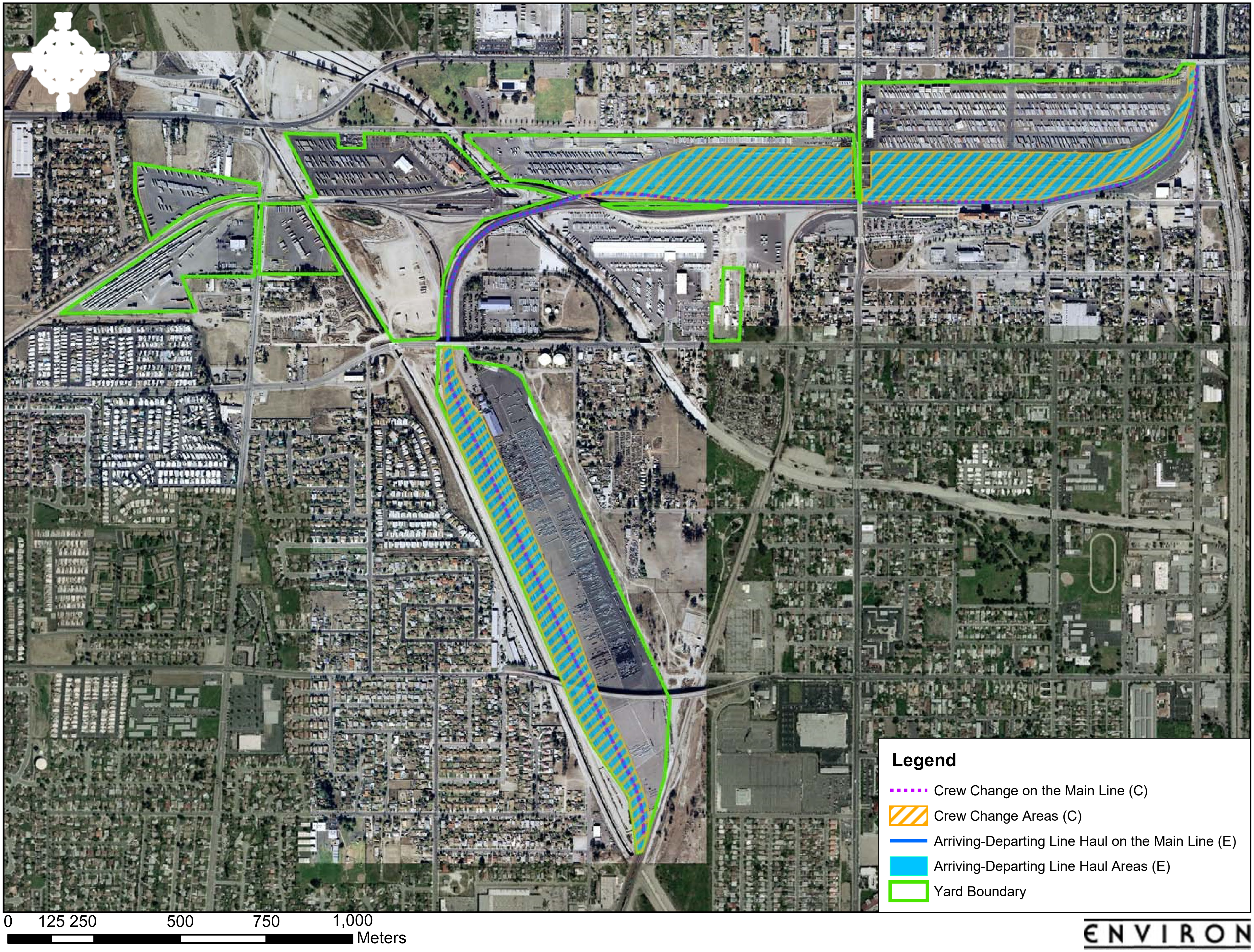


Figure 2-8: Stationary and Movement Locomotive Activities - Passing Line Haul (BNSF and Non-BNSF)
BNSF San Bernardino Rail Yard
San Bernardino, California

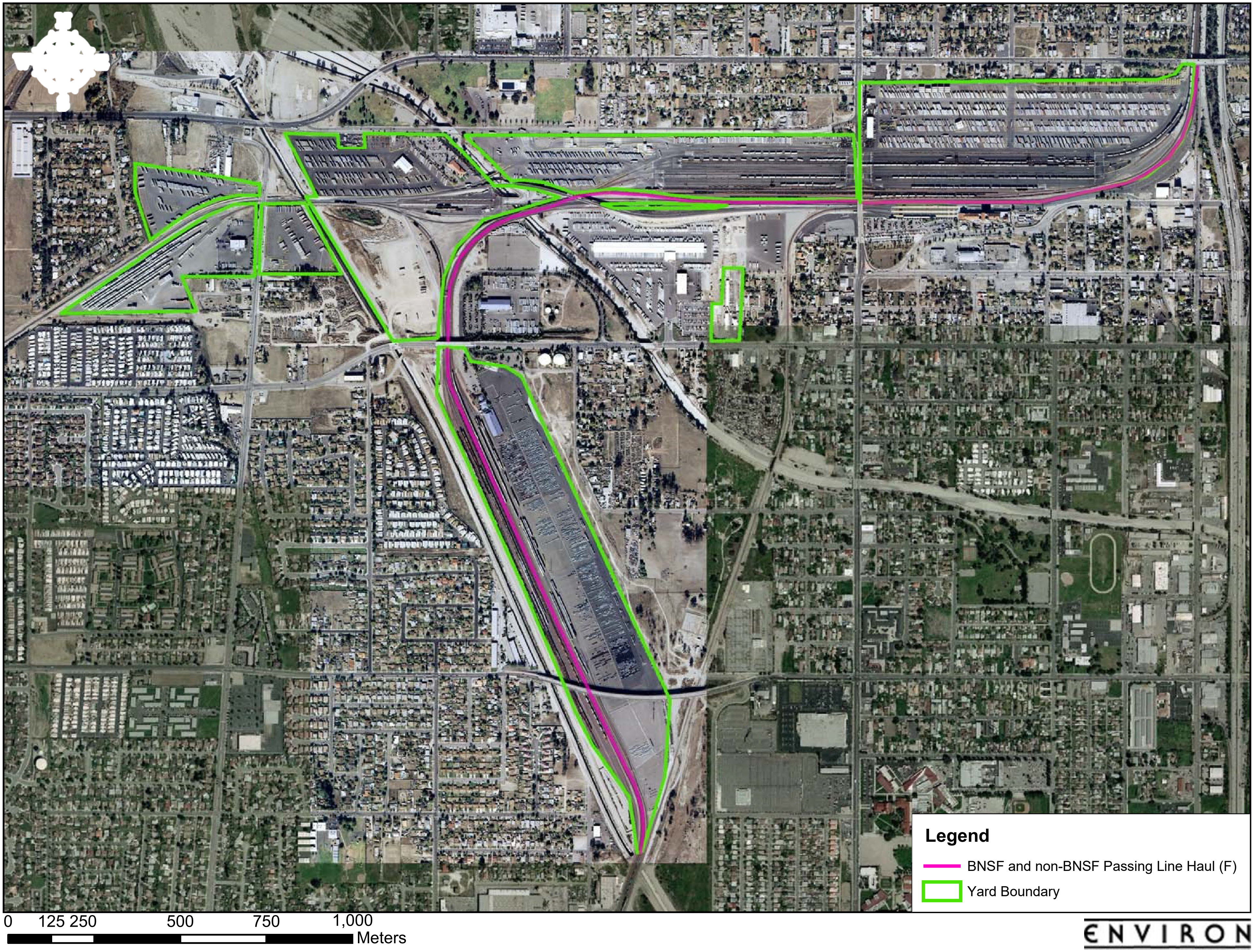


Figure 2-9: Cargo Handling Equipment
BNSF San Bernardino Rail Yard
San Bernardino, California

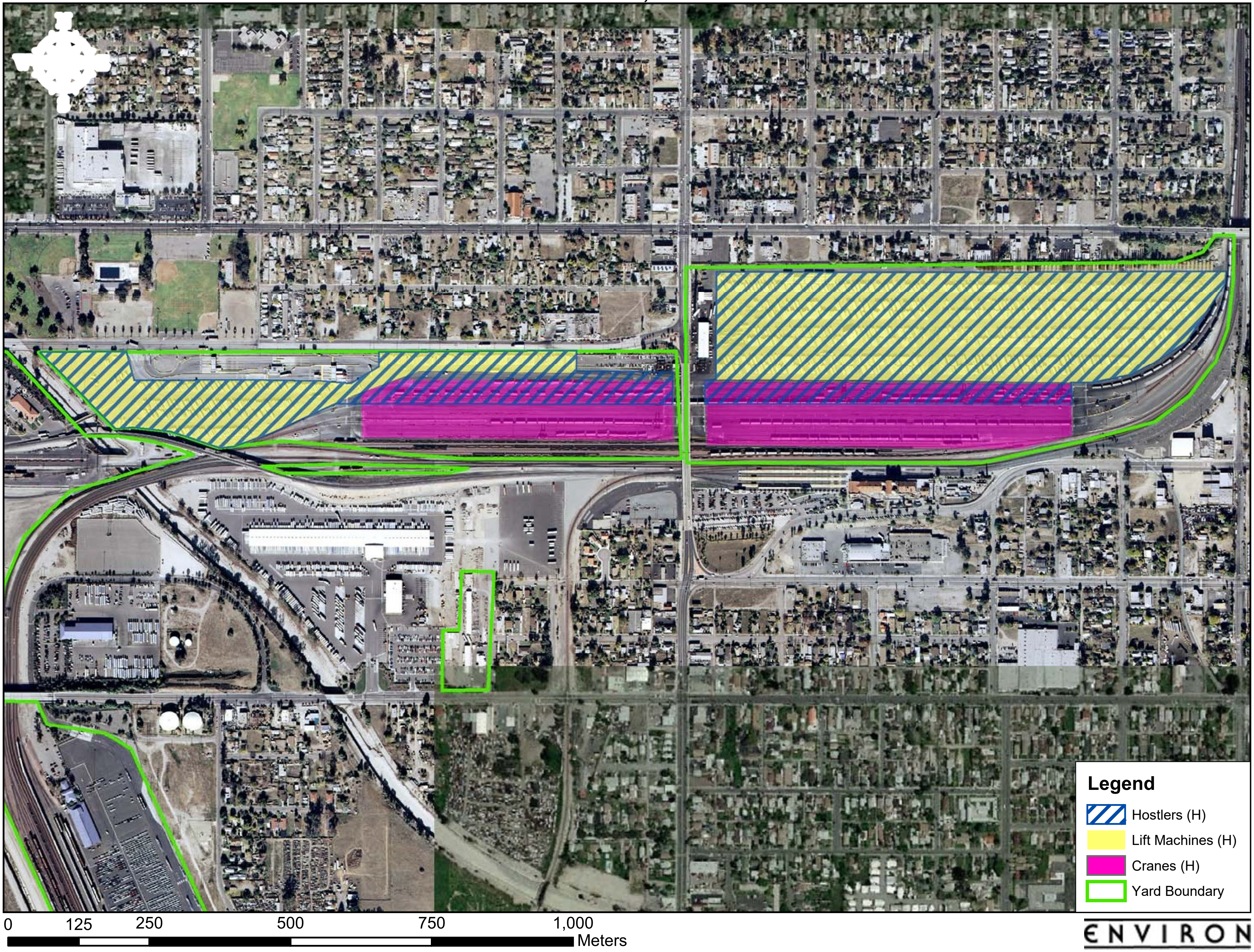


Figure 2-10: Stationary and Movement Locomotive Activities - Passenger Rail
BNSF San Bernardino Rail Yard
San Bernardino, California

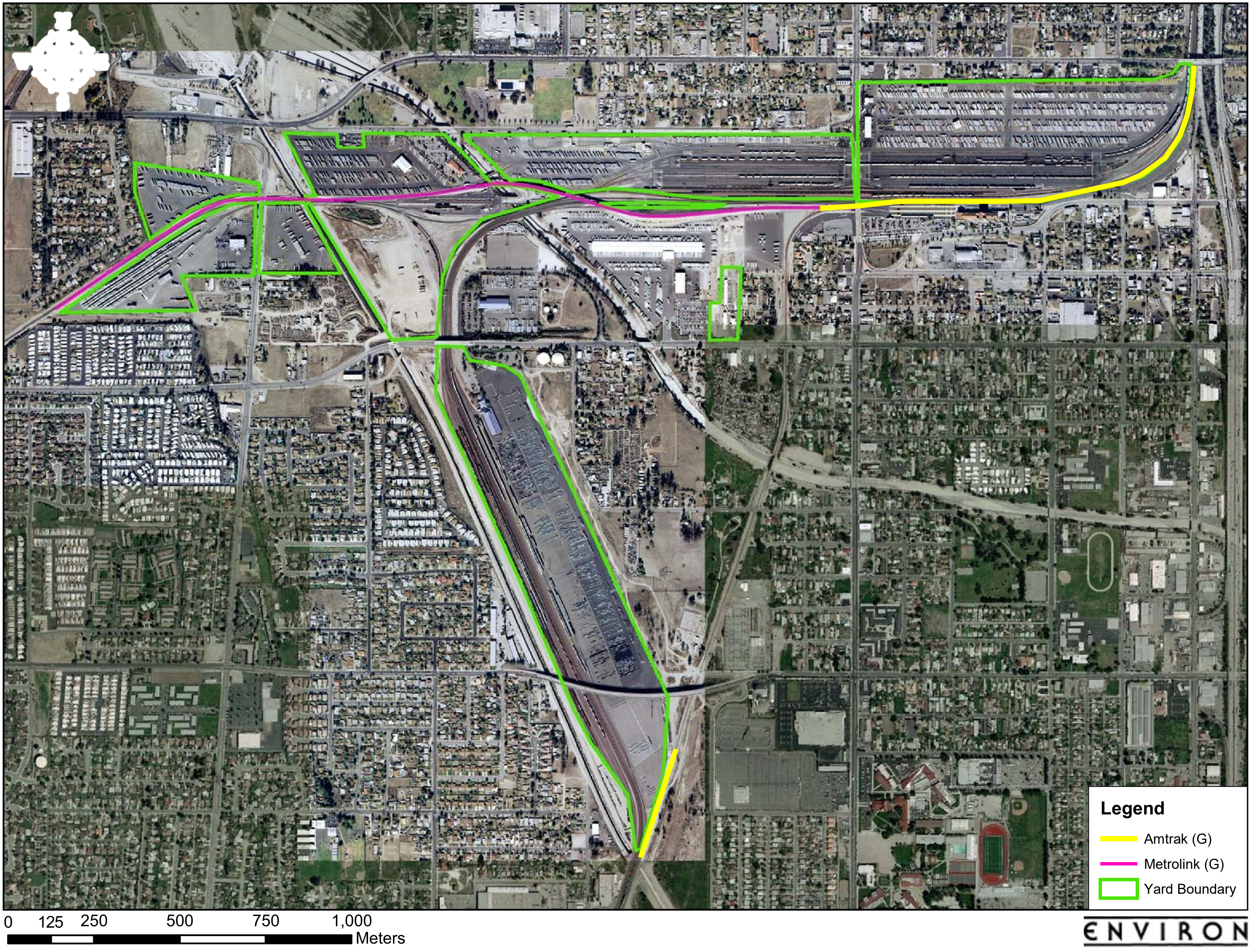


Figure 2-11: On-Road Container Trucks
BNSF San Bernardino Rail Yard
San Bernardino, California

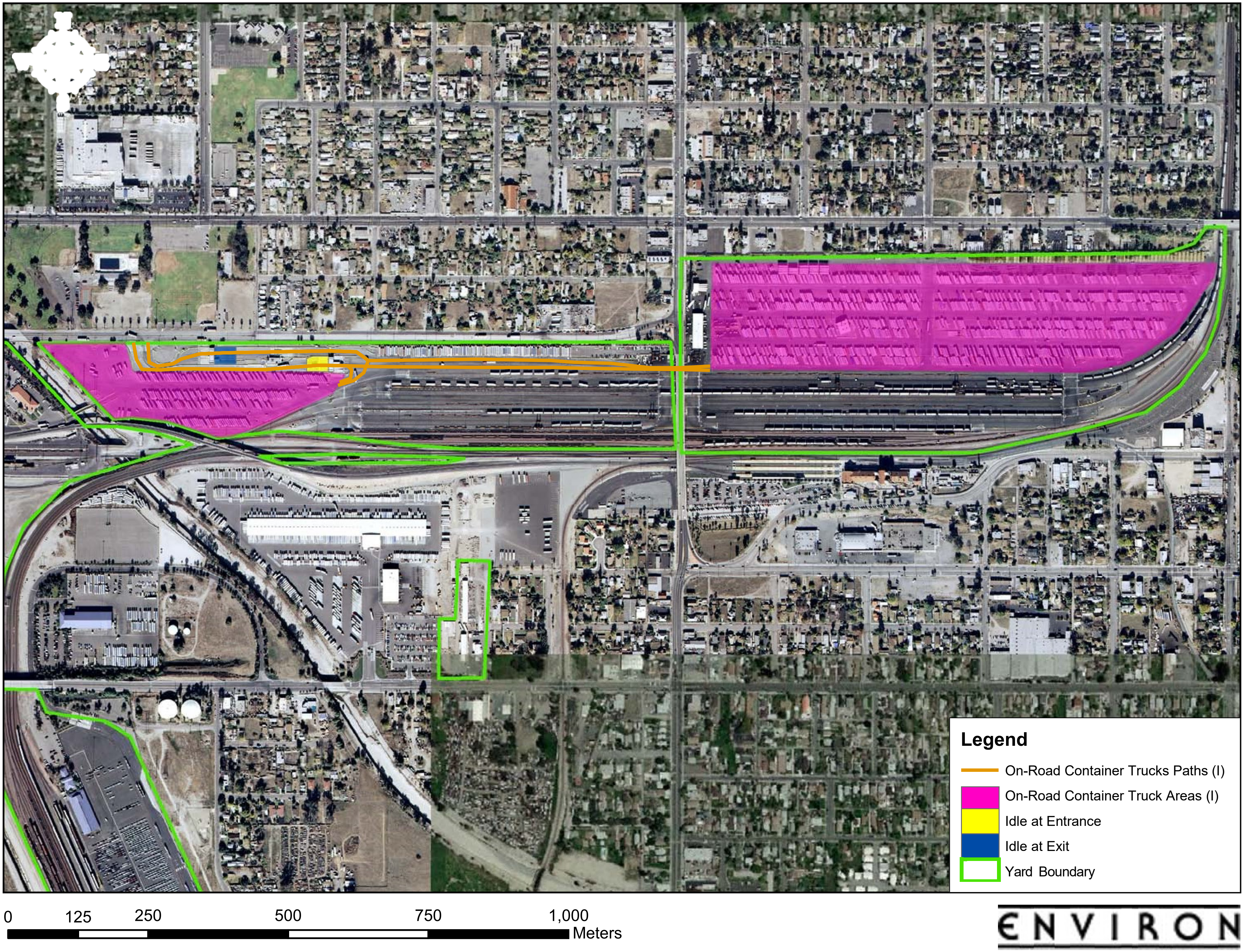


Figure 2-12: On-Road Refueling Trucks
BNSF San Bernardino Rail Yard
San Bernardino, California

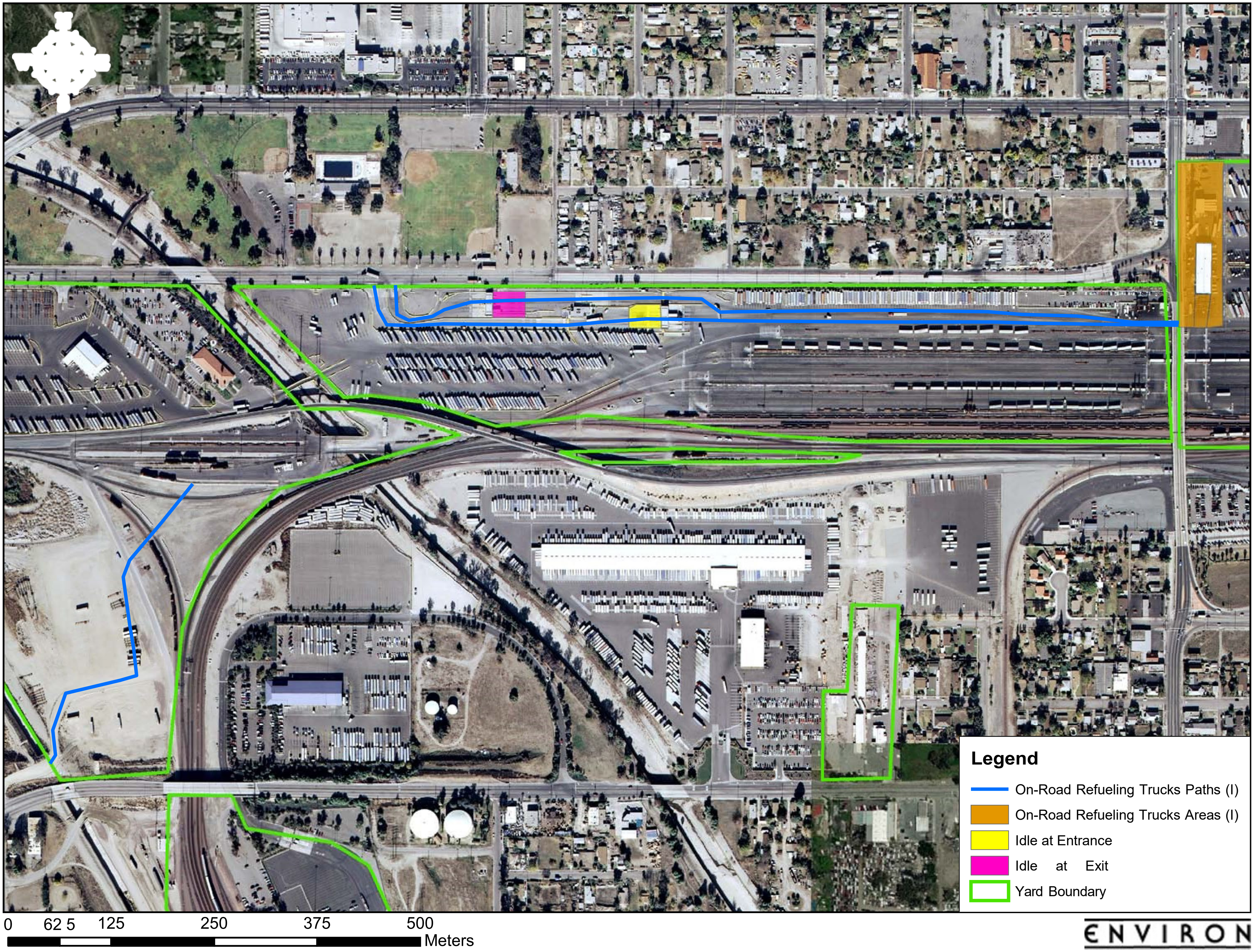


Figure 2-13: On-Road Fleet - BNSF On-Road Fleet and Eagle Fleet
BNSF San Bernardino Rail Yard
San Bernardino, California

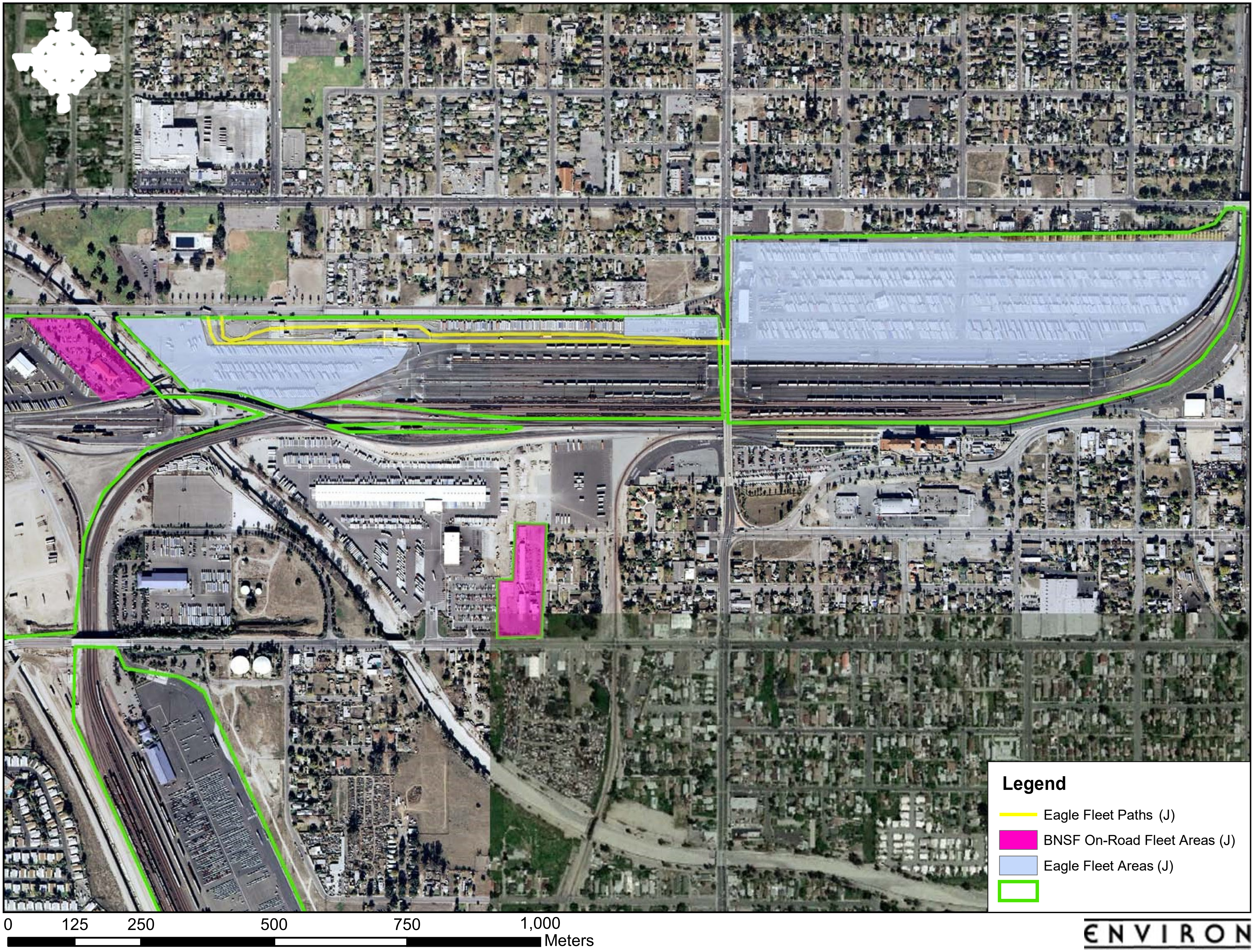


Figure 2-14: On-Road Fleet - Progressive Fleet
BNSF San Bernardino Rail Yard
San Bernardino, California

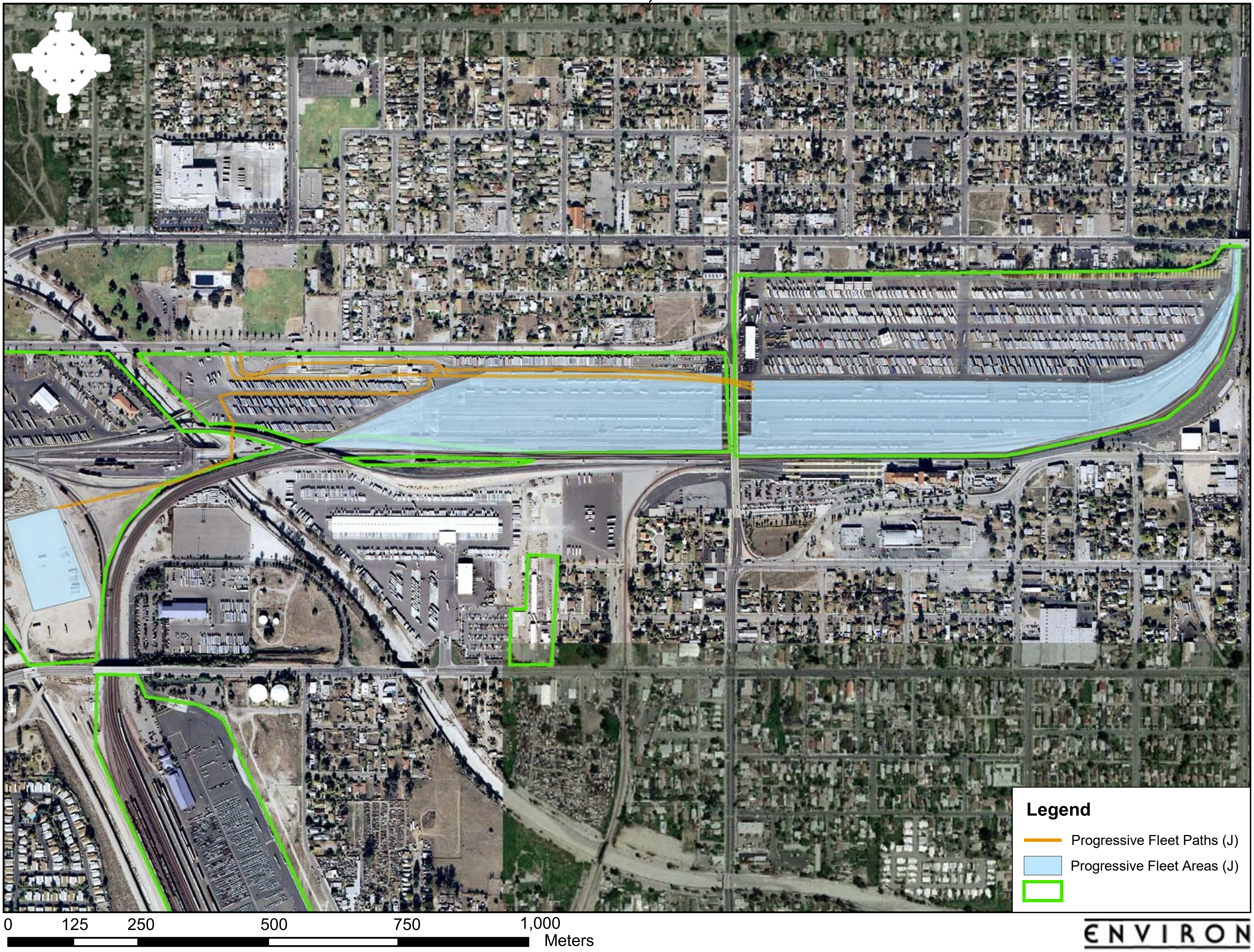


Figure 2-15: Permitted Stationary Sources
BNSF San Bernardino Rail Yard
San Bernardino, California

Figure 2-16: Off-Road Equipment - Transportation Refrigeration Units ("B" Yard)
BNSF San Bernardino Rail Yard
San Bernardino, California

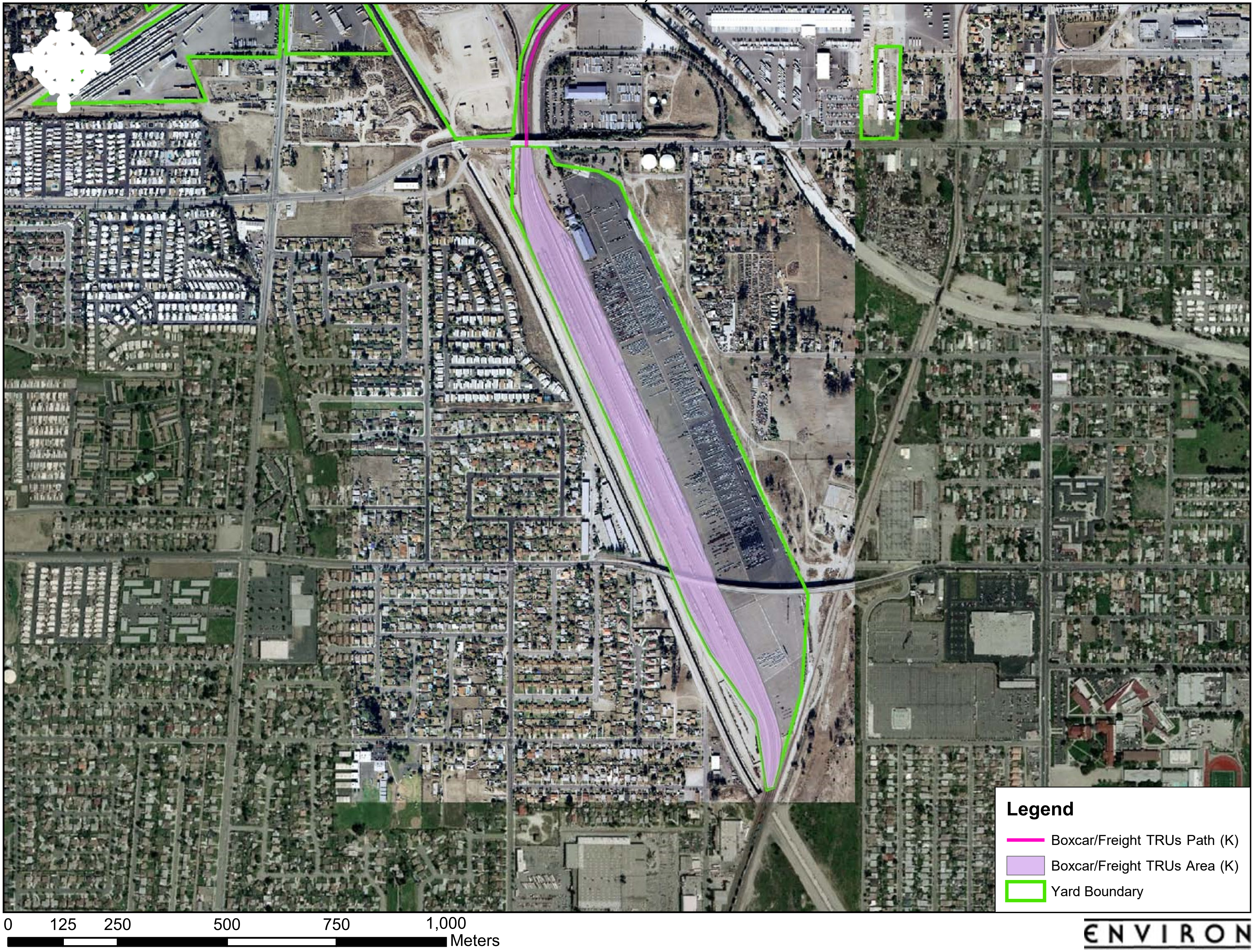


Figure 4-1a: Locations of Modeled Stationary Locomotive Sources - Idling while Refueling and Switching
BNSF San Bernardino Rail Yard
San Bernardino, California

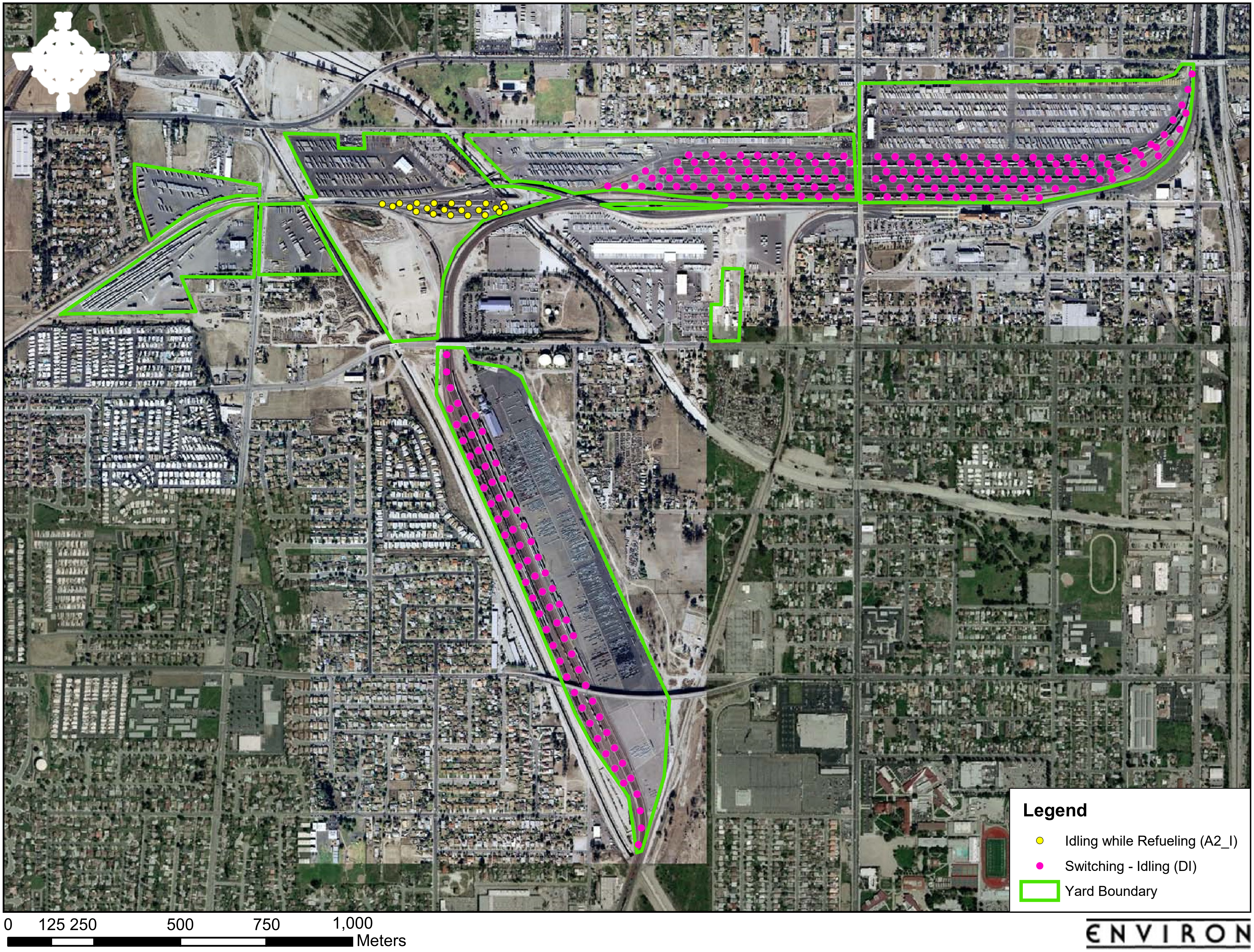


Figure 4-1b: Locations of Modeled Stationary Locomotive Sources - Arriving-Departing Line Haul and Crew Change
BNSF San Bernardino Rail Yard
San Bernardino, California

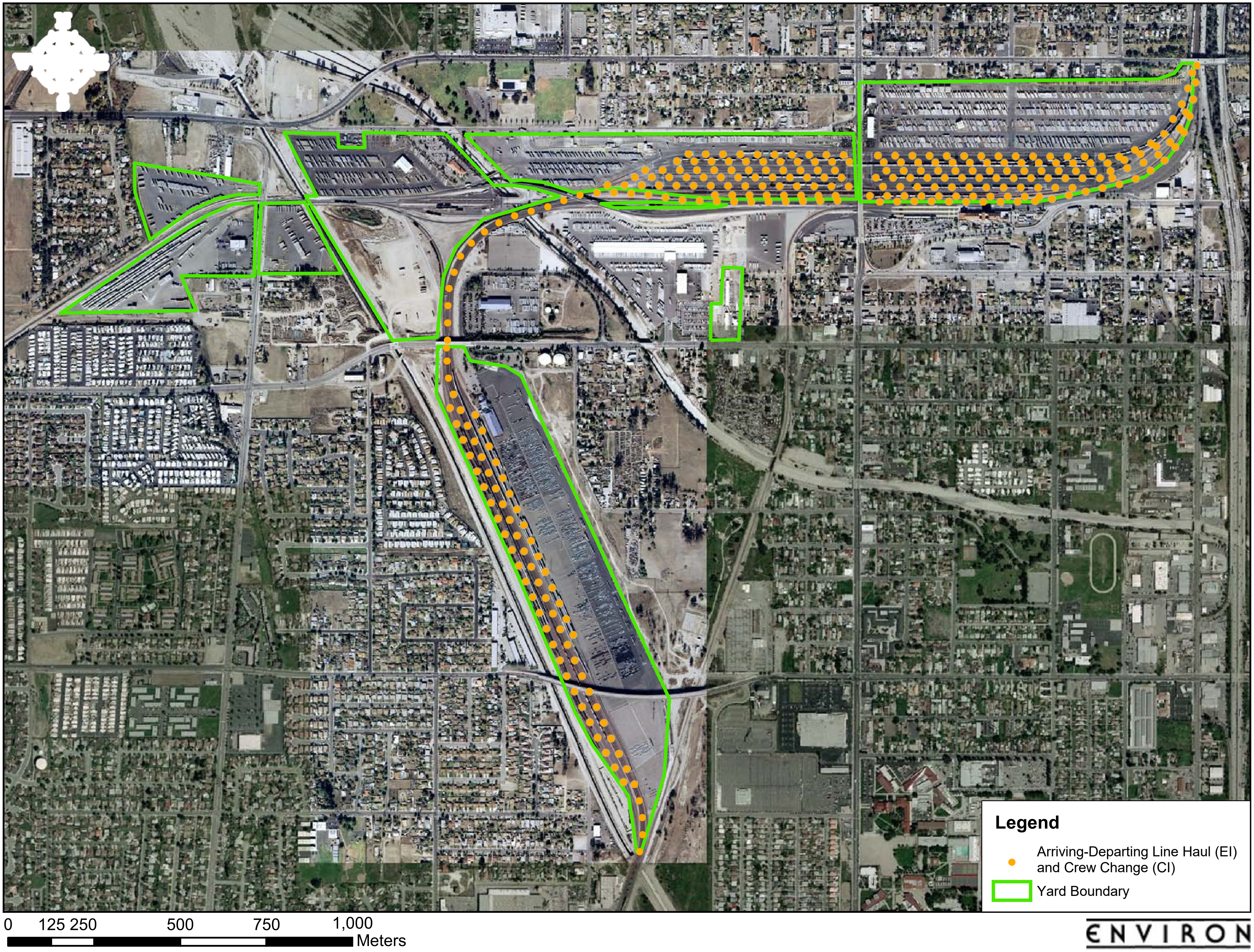


Figure 4-1c: Locations of Modeled Stationary Locomotive Sources - BNSF Passing Line Haul
BNSF San Bernardino Rail Yard
San Bernardino, California

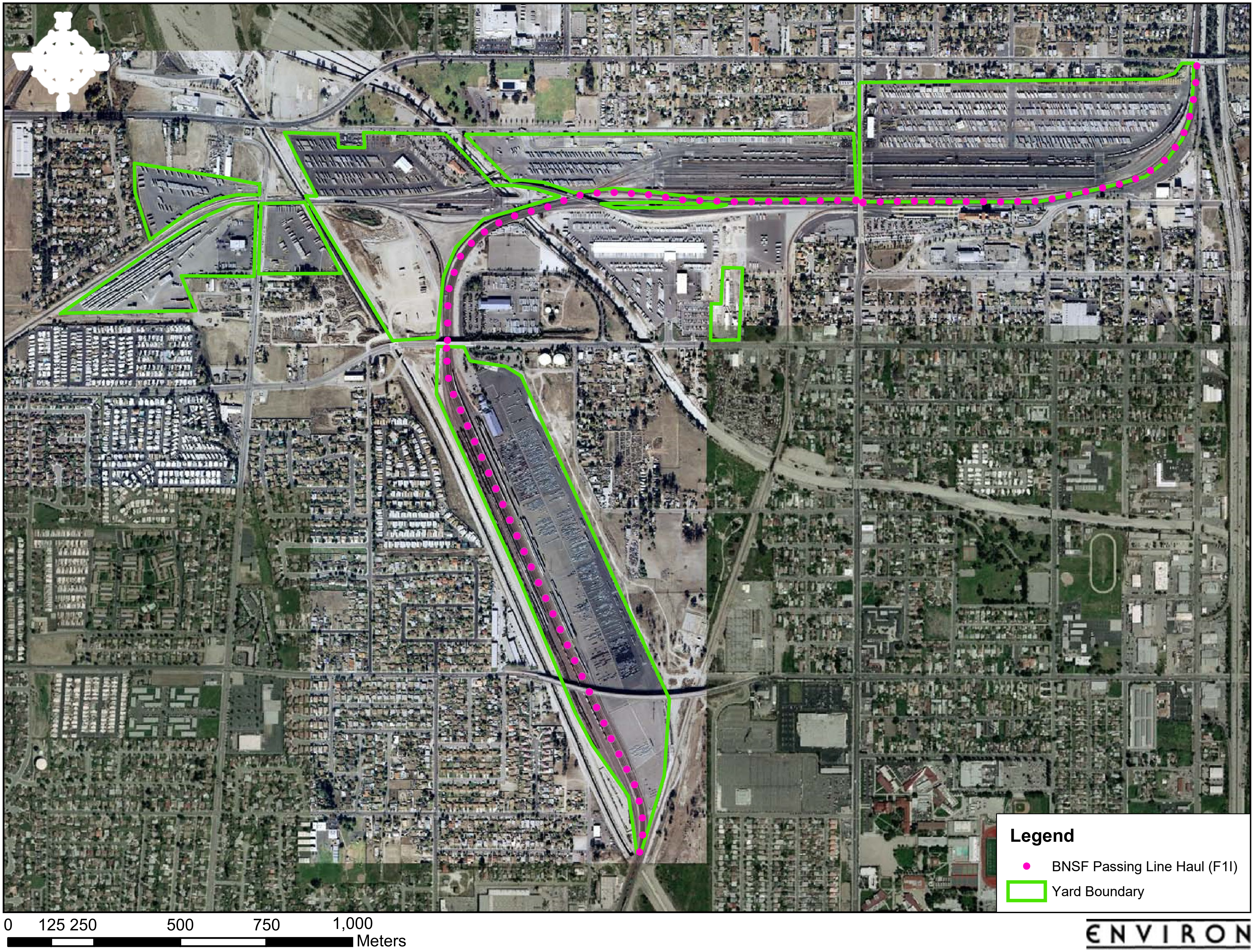


Figure 4-1d: Locations of Modeled Stationary Locomotive Sources - Passenger Rail
BNSF San Bernardino Rail Yard
San Bernardino, California

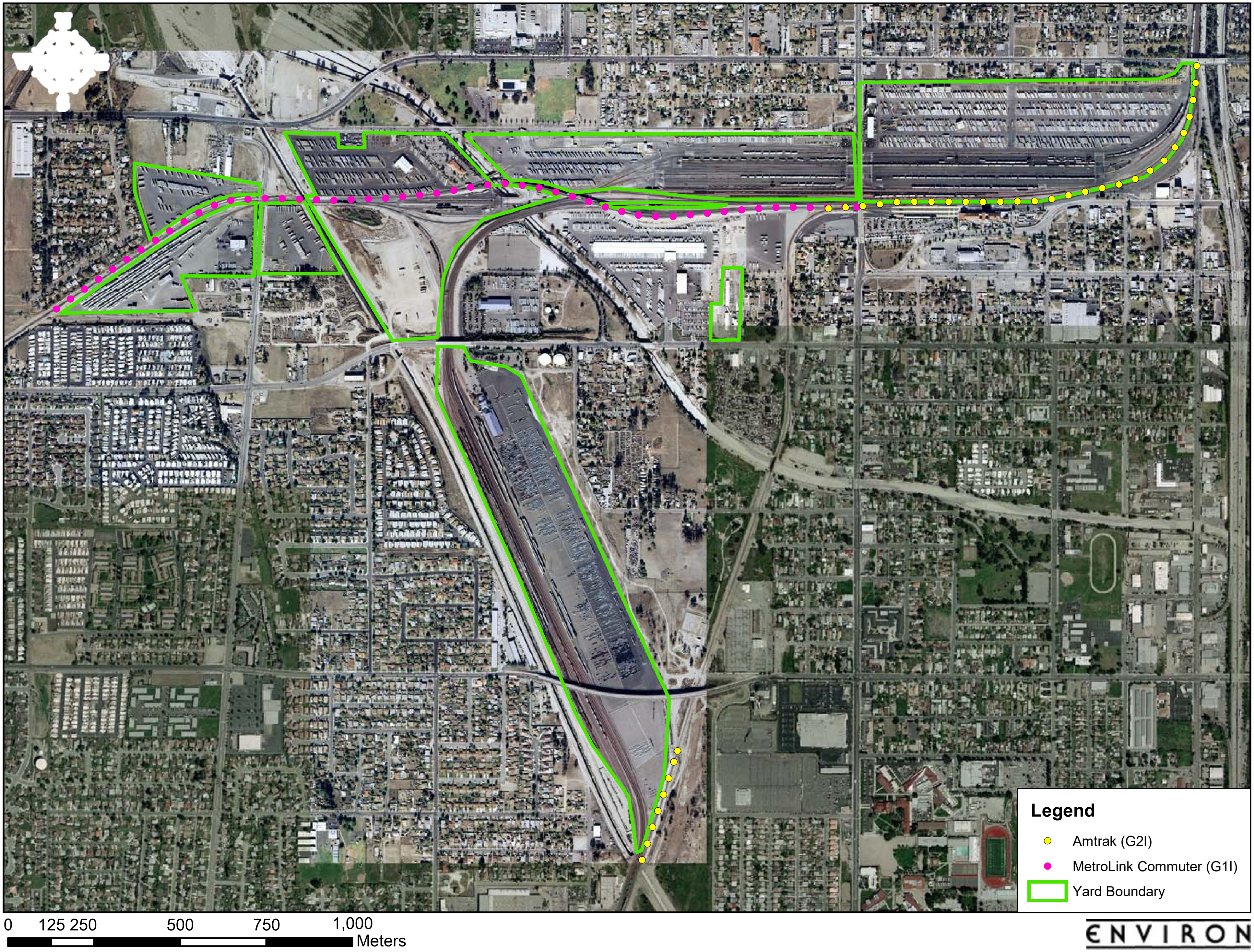


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Figure 4-2a: Locations of Modeled Movement Locomotive Sources - Switching
BNSF San Bernardino Rail Yard
San Bernardino, California

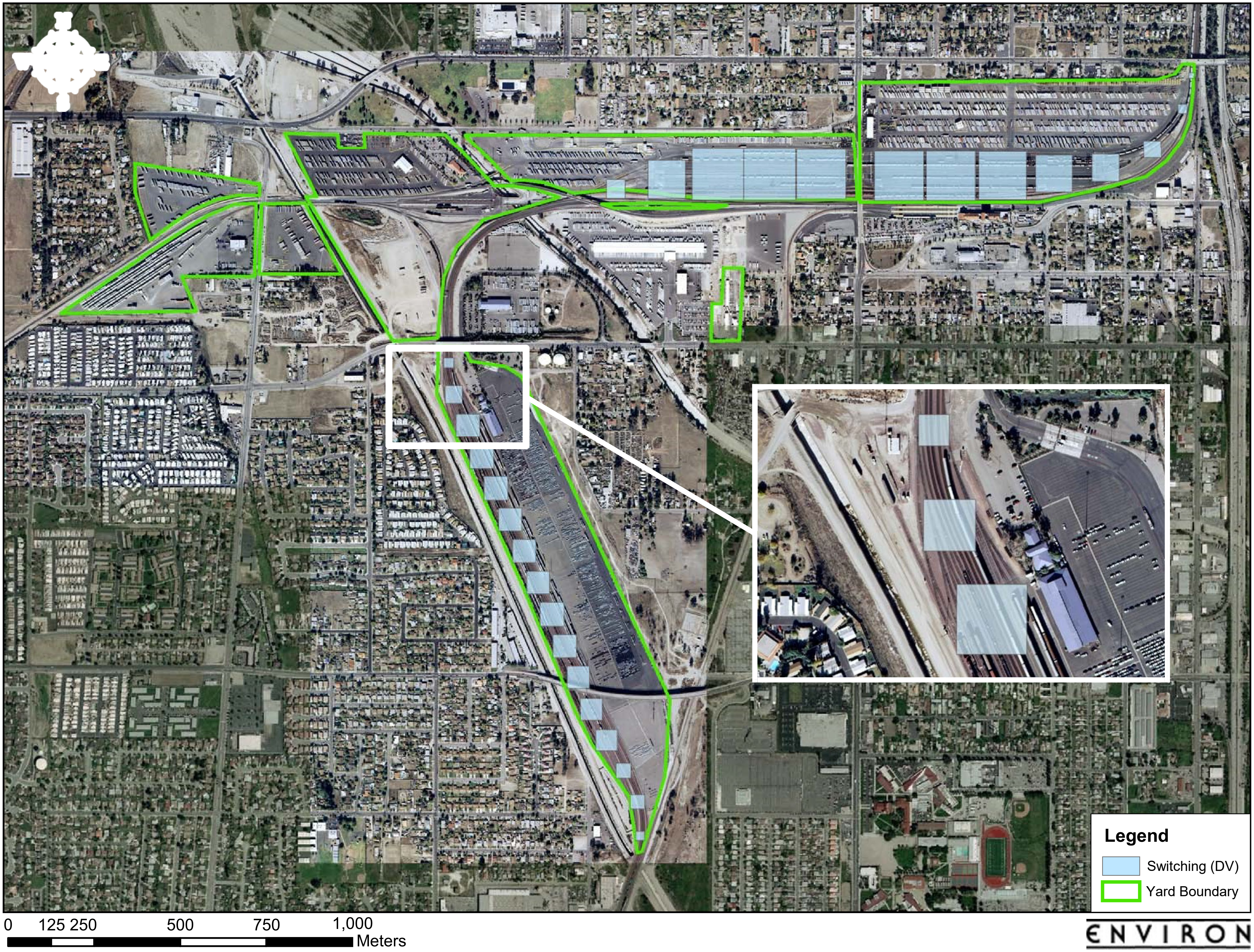
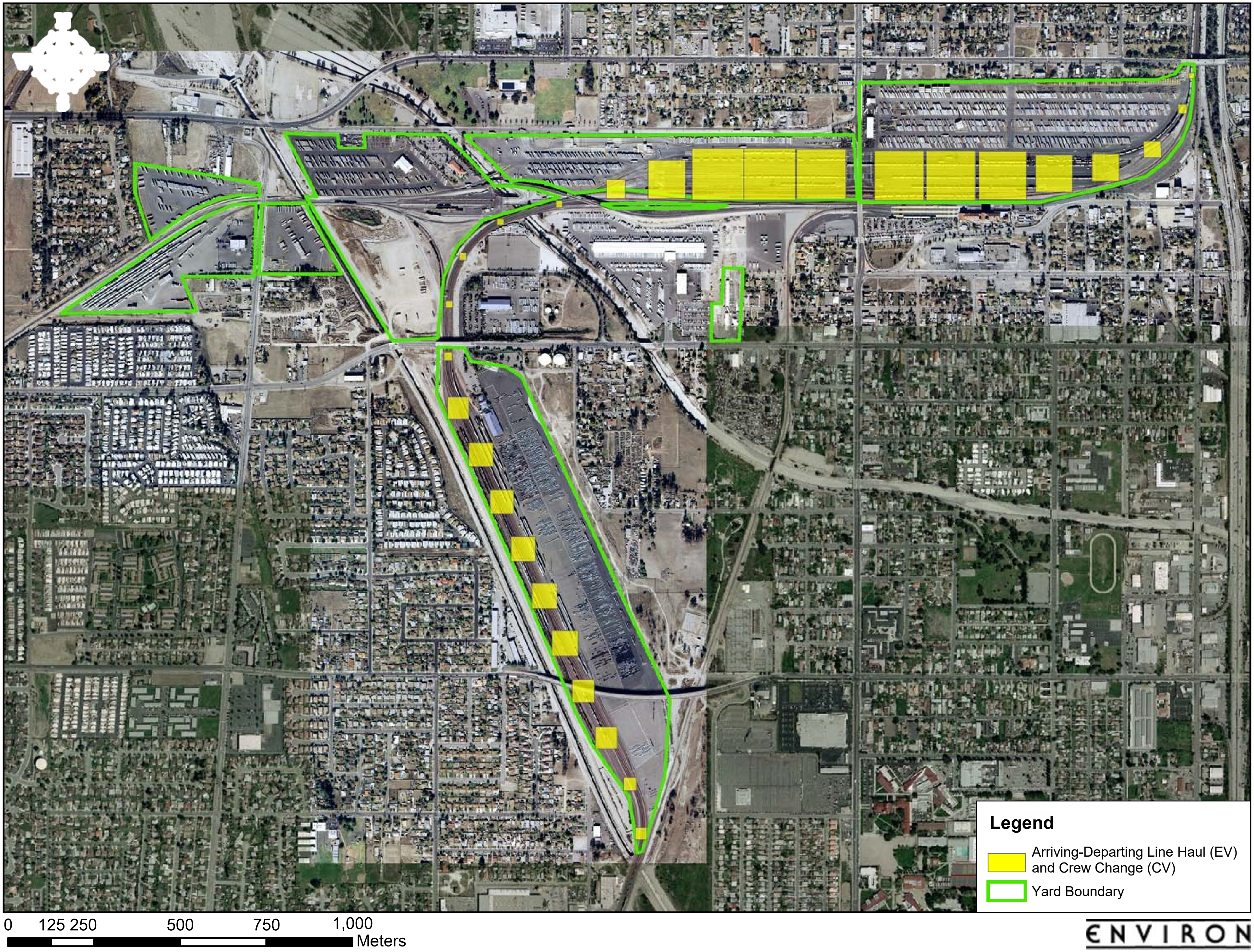


Figure 4-2b: Locations of Modeled Movement Locomotive Sources - Arriving-Departing Line Haul and Crew Change
BNSF San Bernardino Rail Yard
San Bernardino, California



ENVIRON

Figure 4-2c: Locations of Modeled Movement Locomotive Sources - Passing Line Haul (BNSF and Non-BNSF)
BNSF San Bernardino Rail Yard
San Bernardino, California

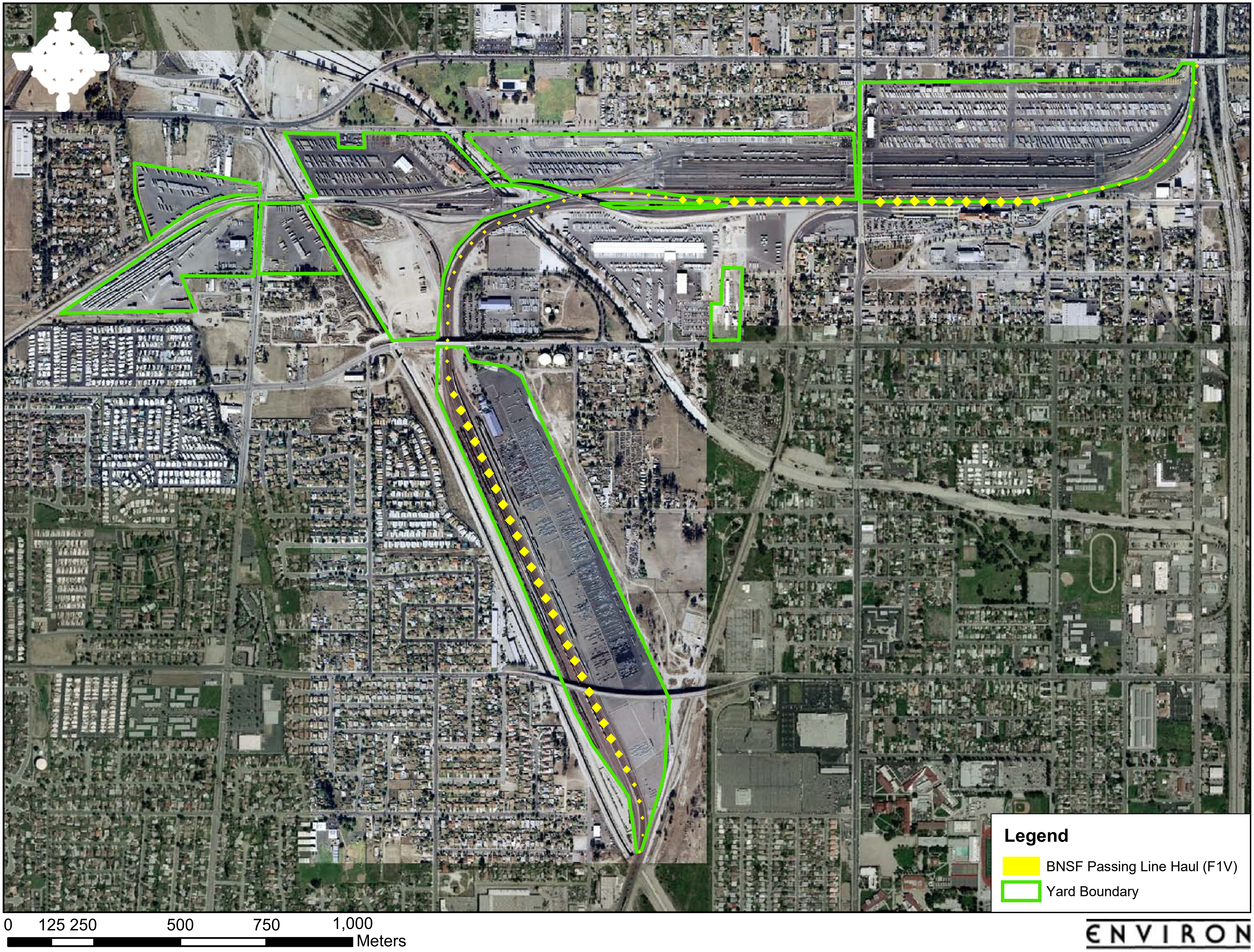


Figure 4-2d: Locations of Modeled Movement Locomotive Sources - Passenger Rail
BNSF San Bernardino Rail Yard
San Bernardino, California

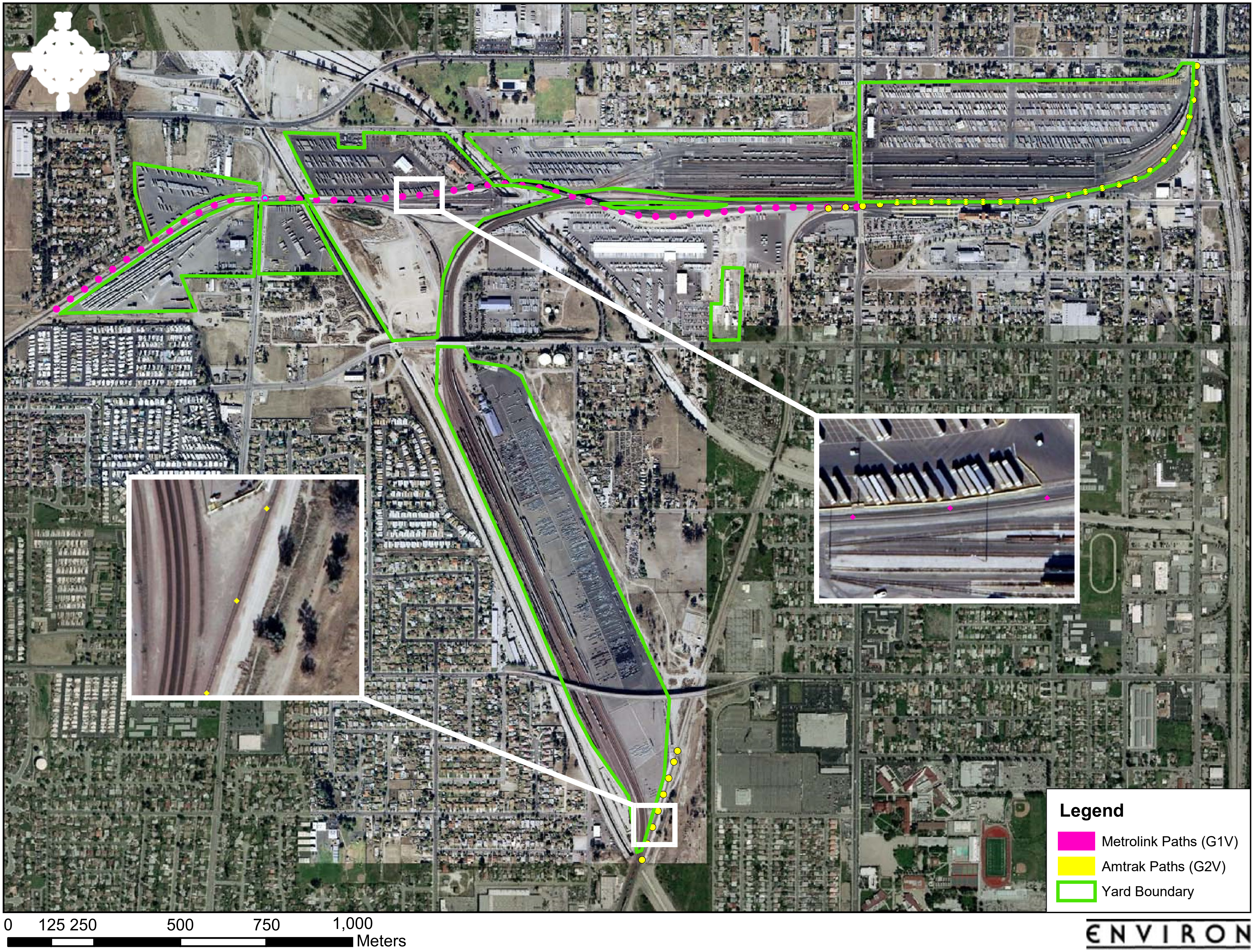


Figure 4-3a: Locations of Modeled Cargo Handling Equipment Sources - Lift Machines
BNSF San Bernardino Rail Yard
San Bernardino, California

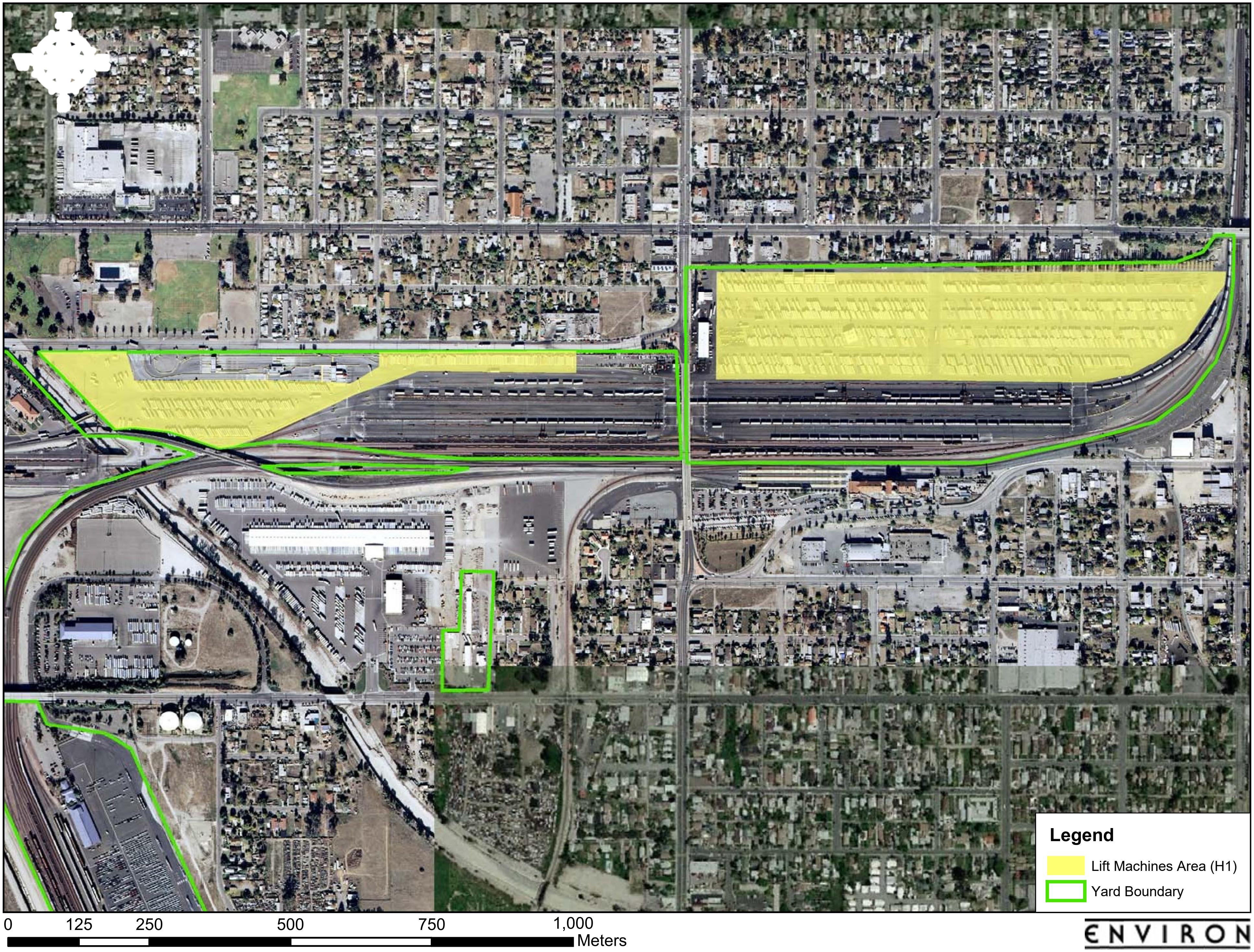


Figure 4-3b: Locations of Modeled Cargo Handling Equipment Sources - Cranes
BNSF San Bernardino Rail Yard
San Bernardino, California

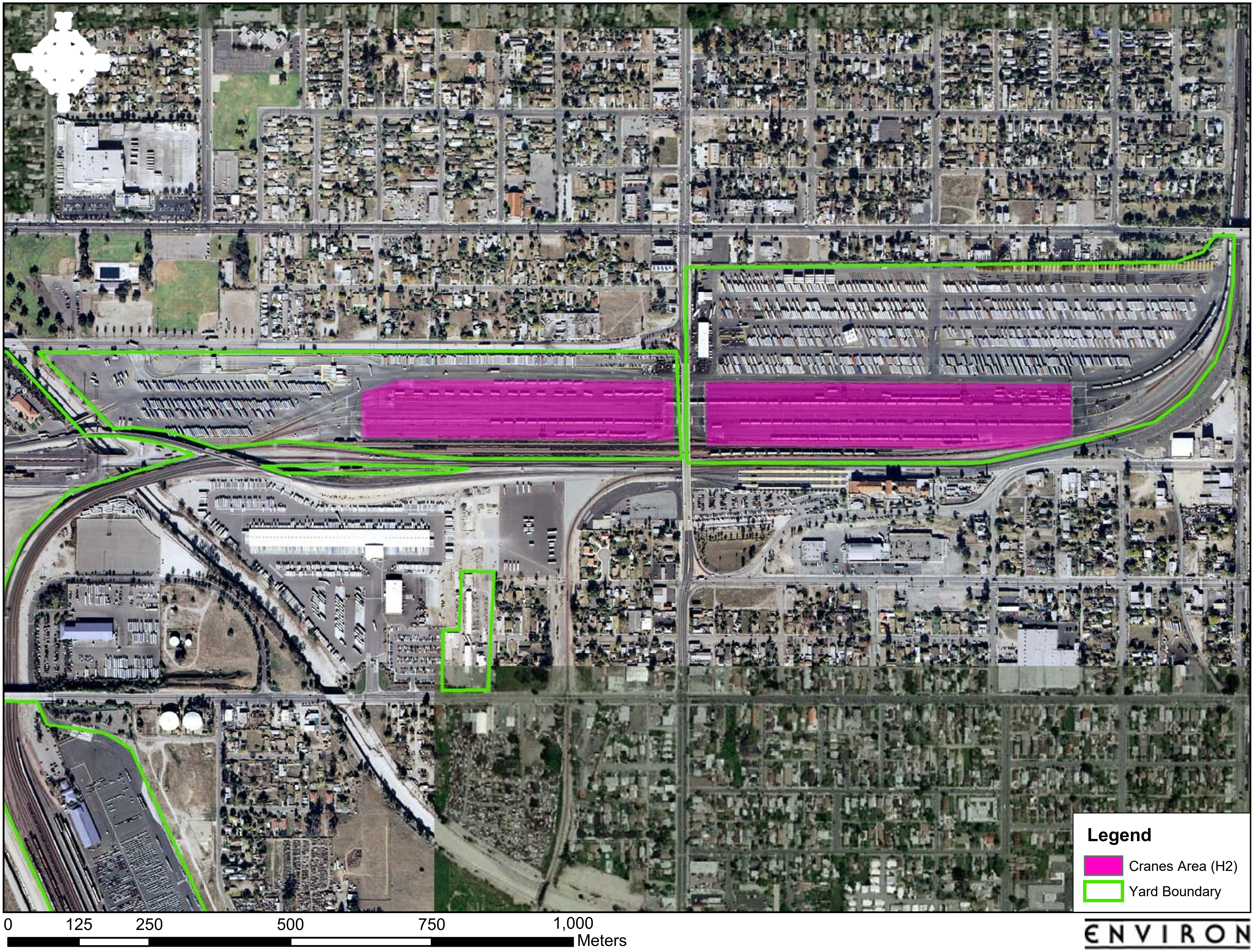


Figure 4-3c: Locations of Modeled Cargo Handling Equipment Sources - Hostlers
BNSF San Bernardino Rail Yard
San Bernardino, California

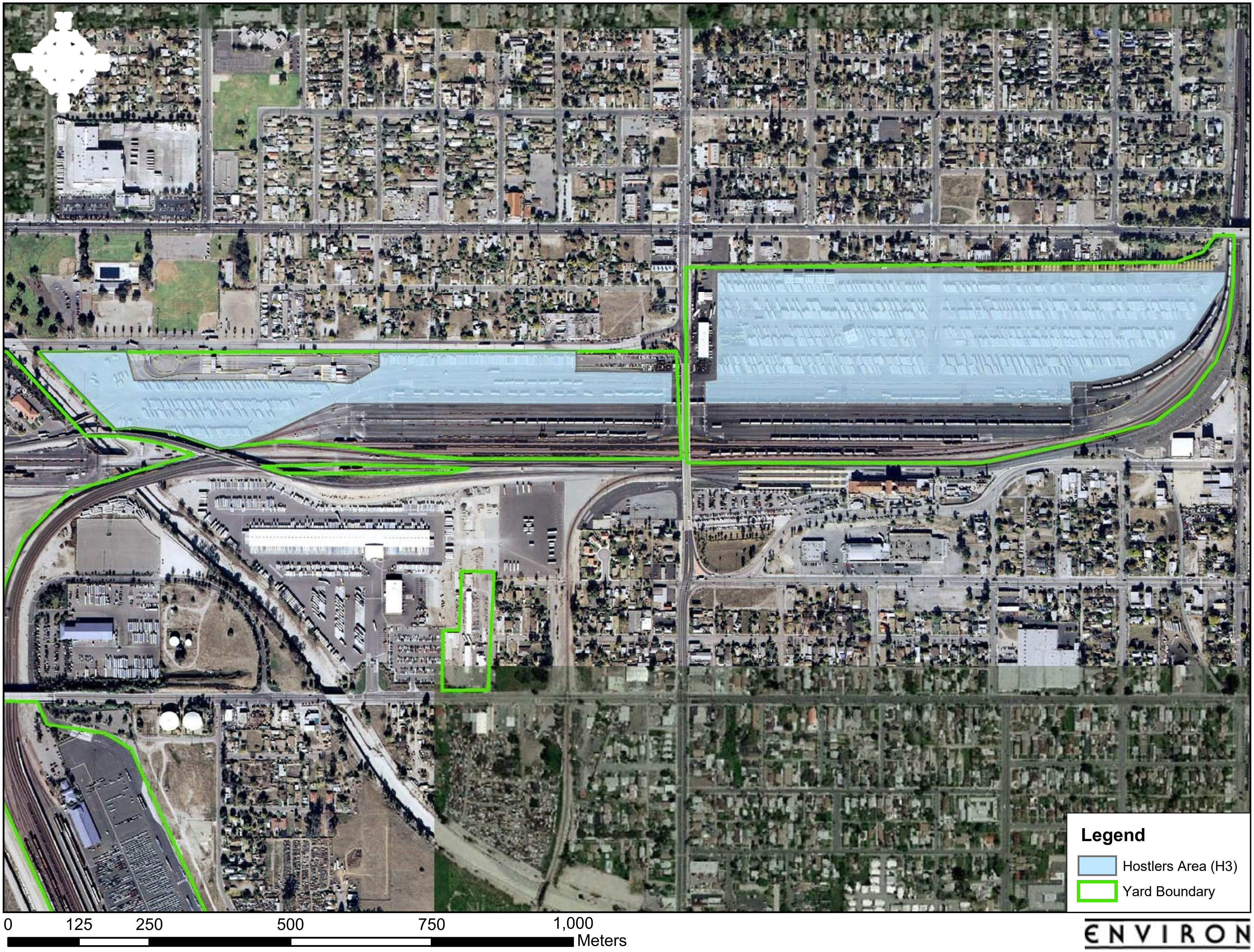


Figure 4-4a: Locations of Modeled On-Road Container Truck Sources
BNSF San Bernardino Rail Yard
San Bernardino, California

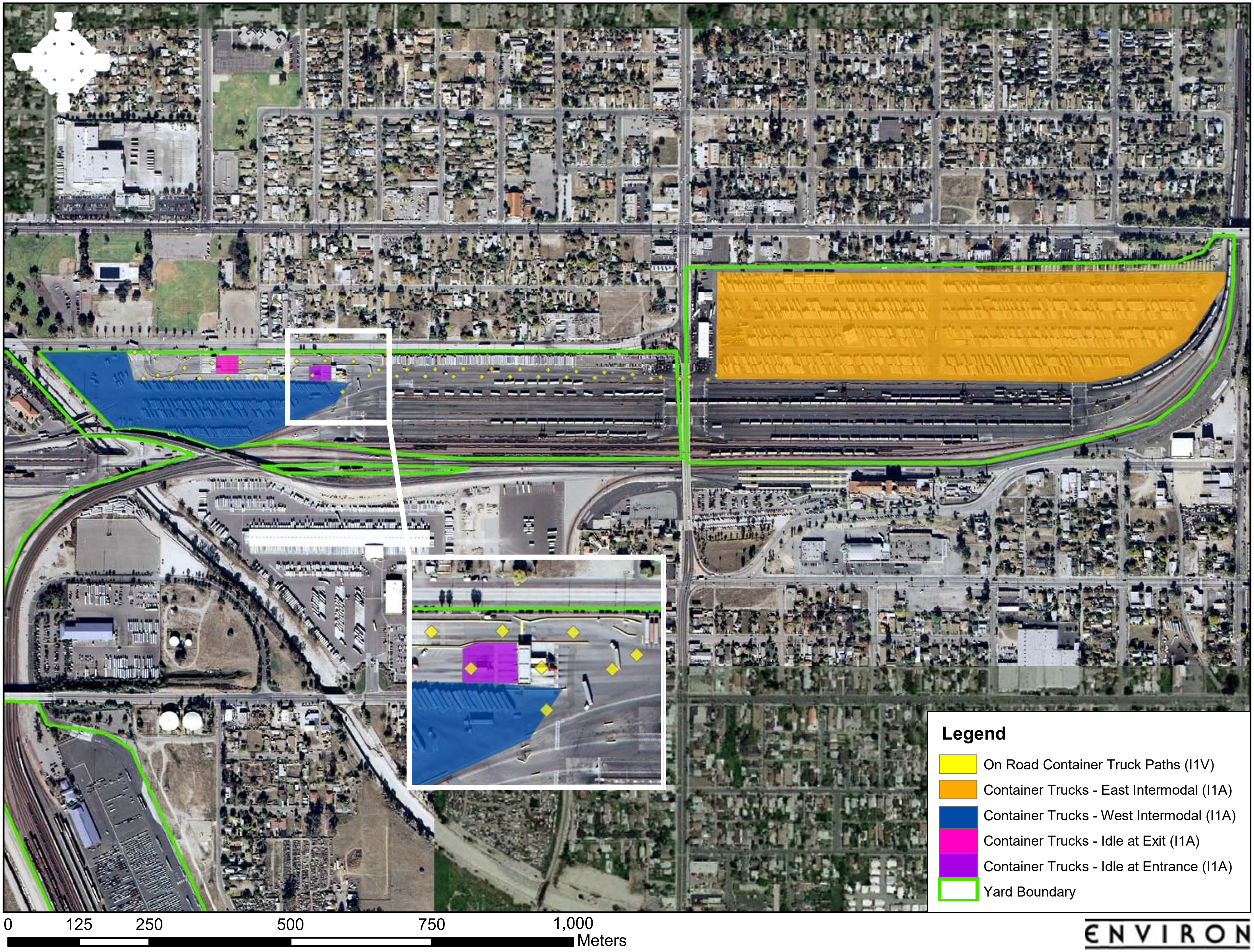
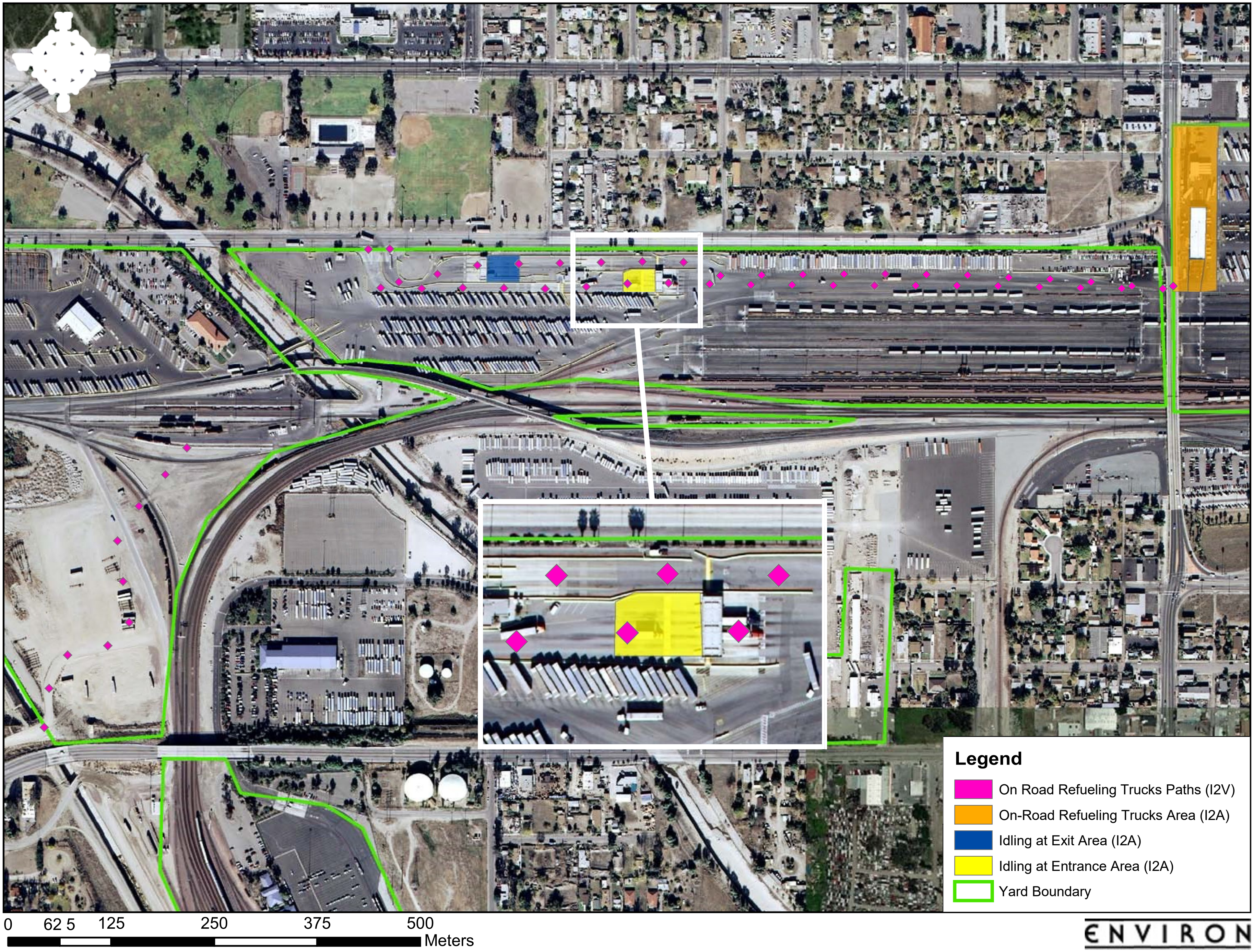


Figure 4-4b: Locations of Modeled On-Road Refueling Truck Sources
BNSF San Bernardino Rail Yard
San Bernardino, California



ENVIRON

Figure 4-5a: Locations of Modeled On-Road Fleet Sources - BNSF On-Road Fleet and Eagle Fleet
BNSF San Bernardino Rail Yard
San Bernardino, California

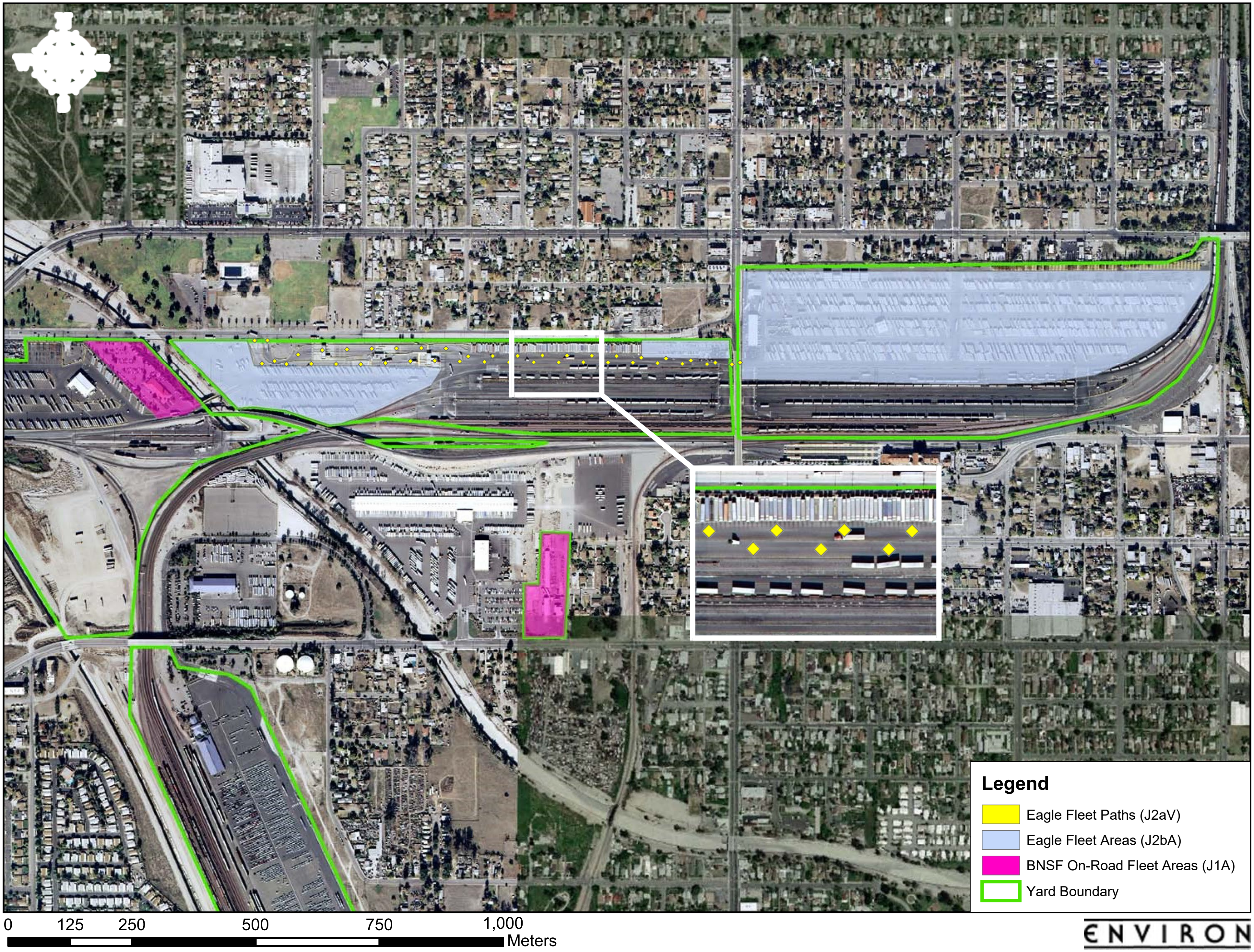


Figure 4-5b: Locations of Modeled On-Road Fleet Sources - Progressive Fleet
BNSF San Bernardino Rail Yard
San Bernardino, California

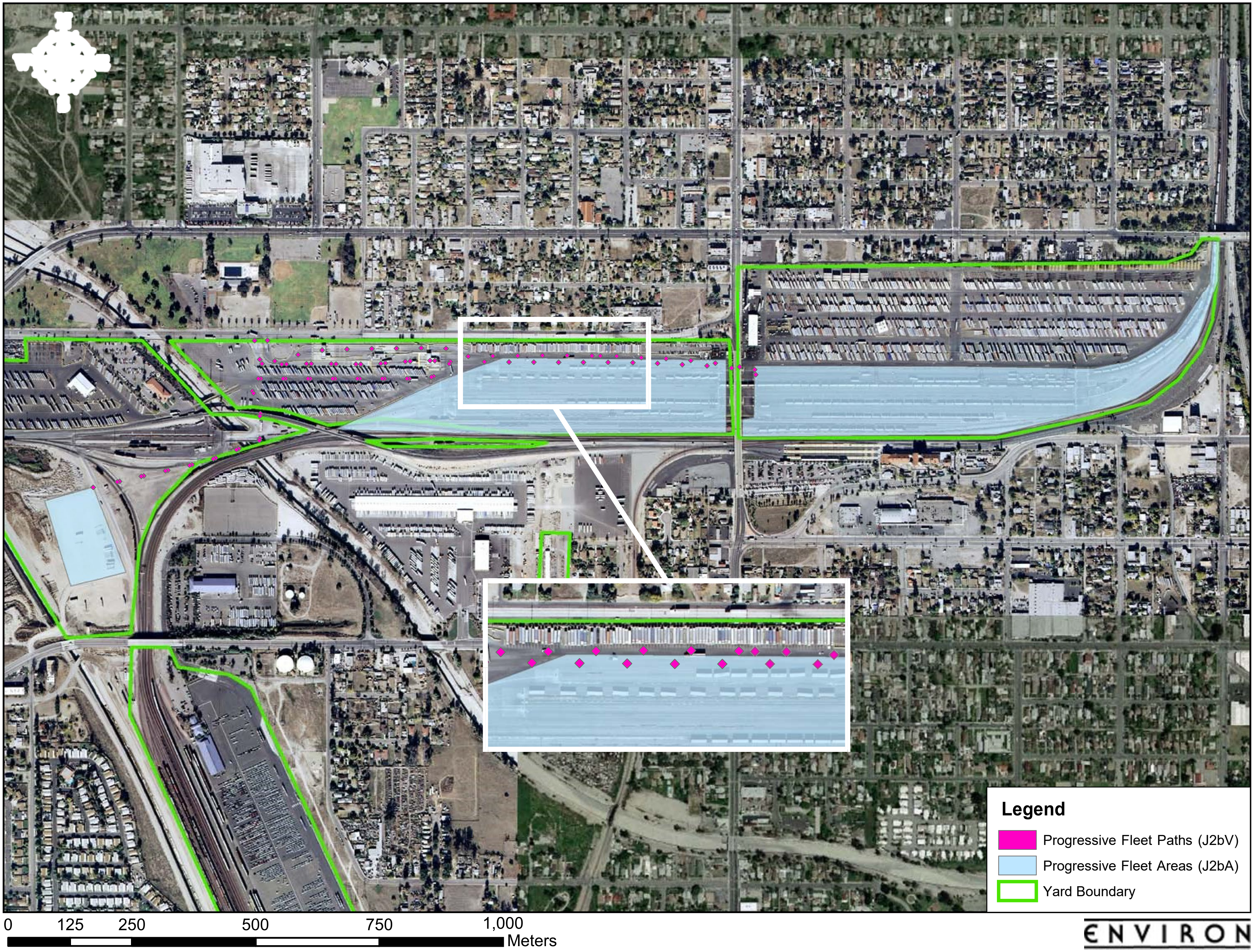


Figure 4-6a: Locations of Modeled Off-Road Sources - Transportation Refrigeration Units
BNSF San Bernardino Rail Yard
San Bernardino, California

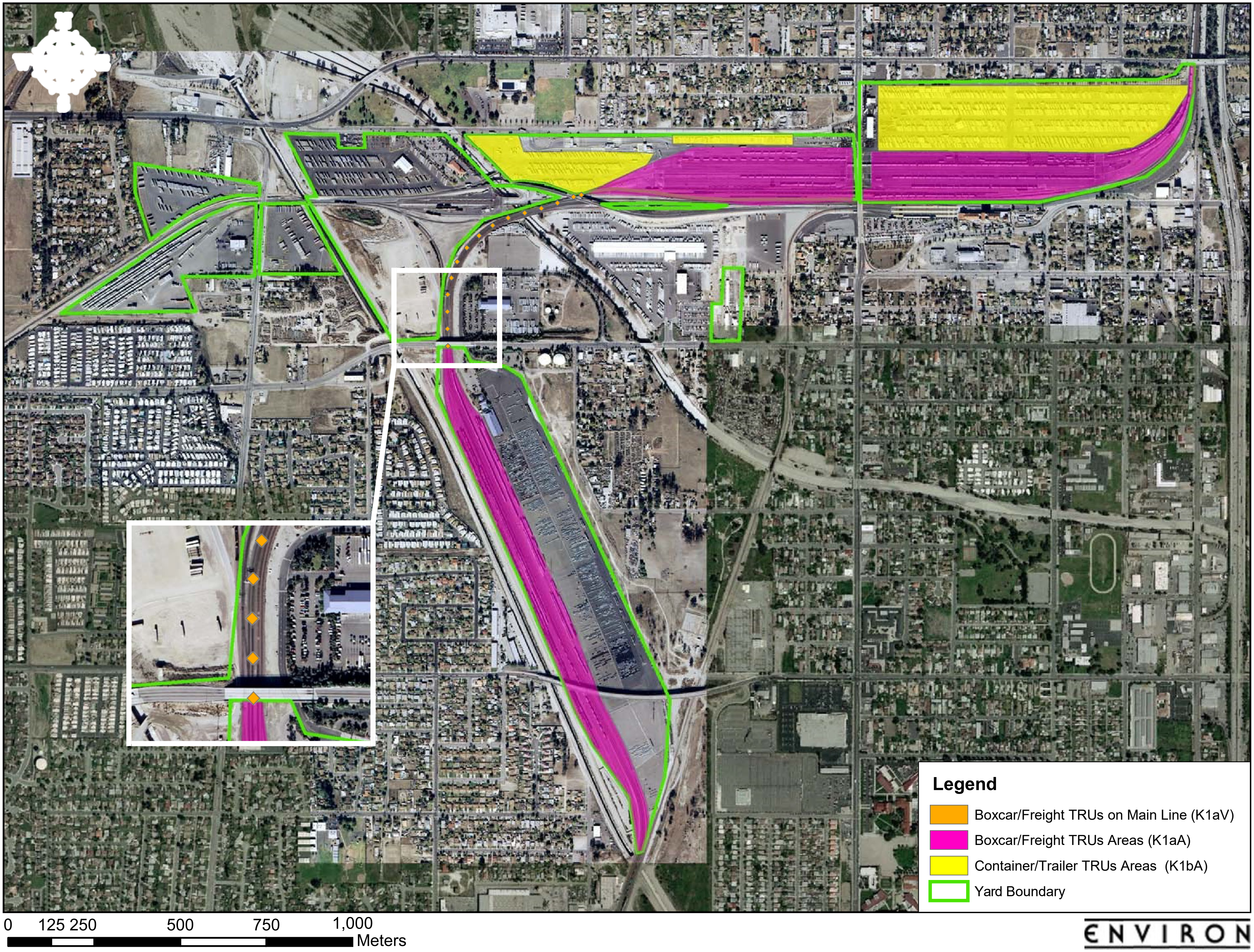


Figure 4-6b: Locations of Modeled Off-Road Sources - Track Maintenance Equipment
BNSF San Bernardino Rail Yard
San Bernardino, California

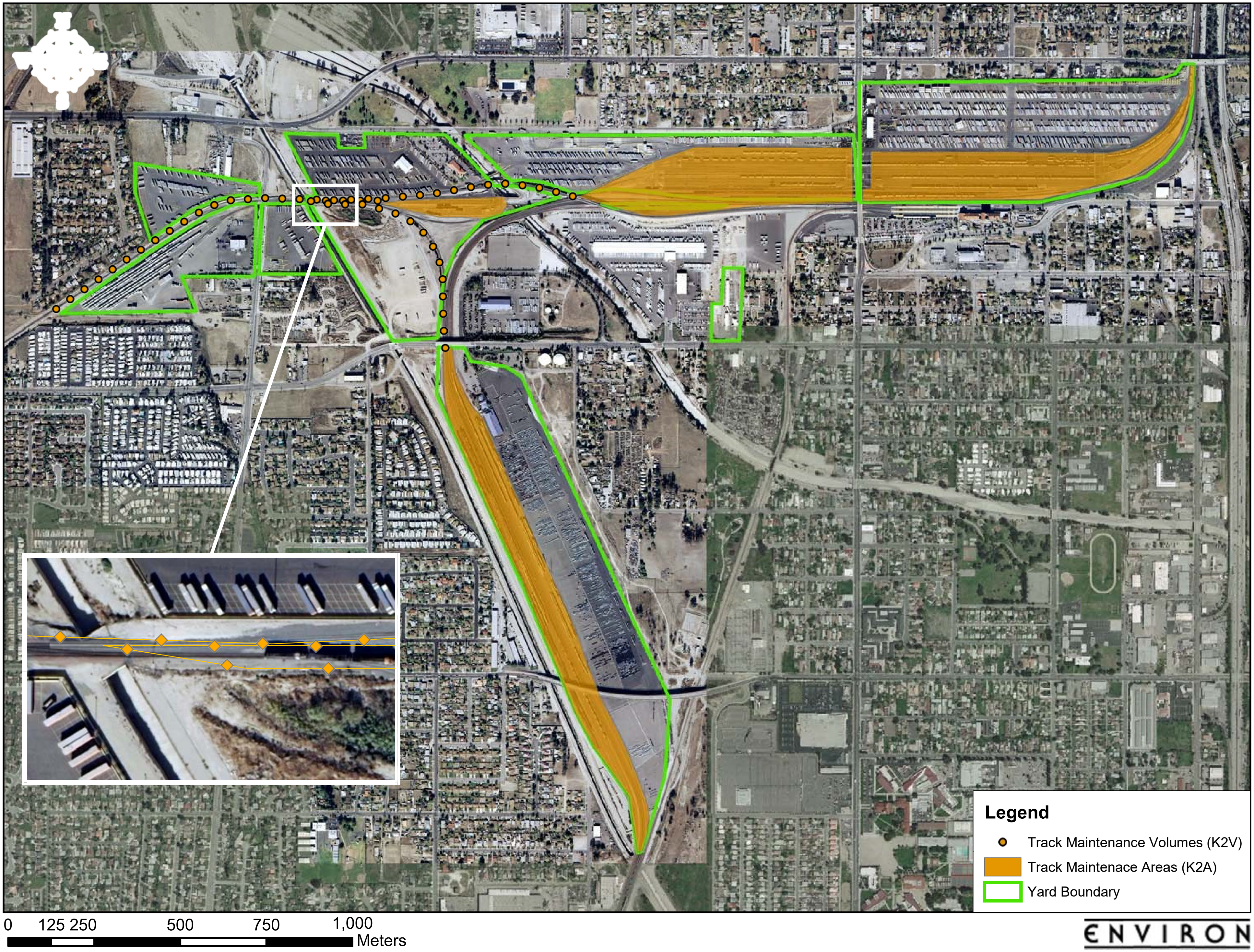


Figure 4-7: Location of Modeled Permitted Stationary Source
BNSF San Bernardino Rail Yard
San Bernardino, California

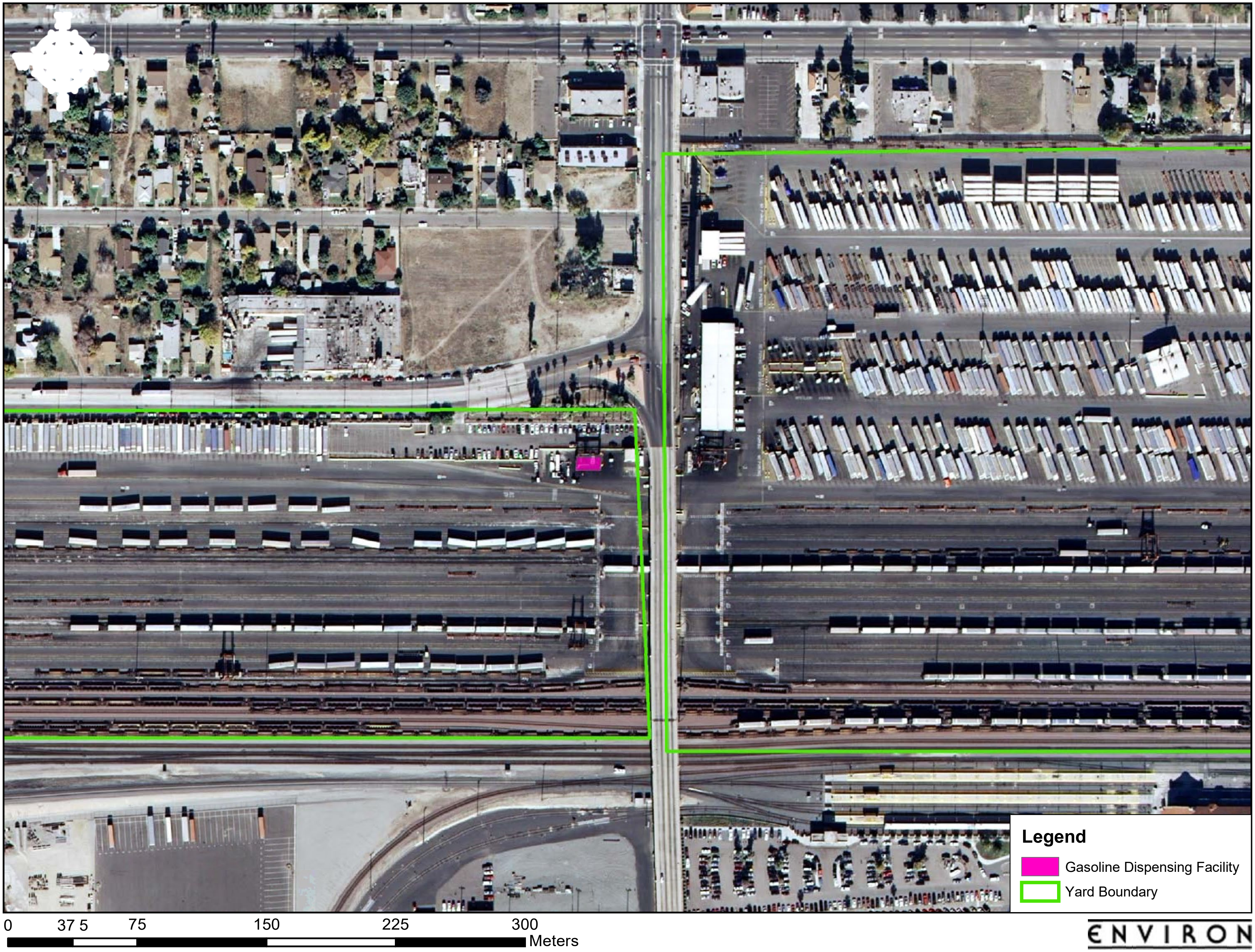
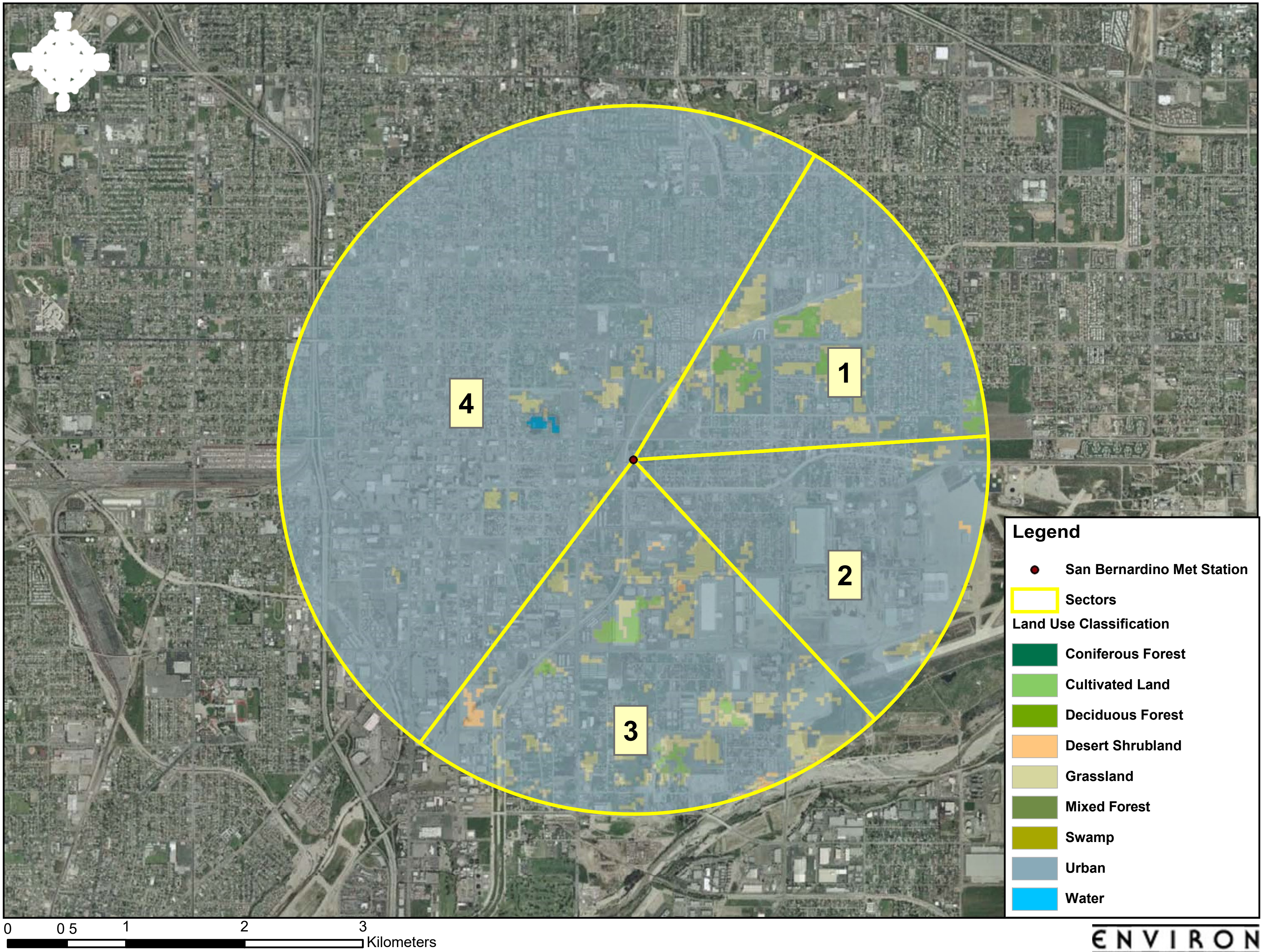


Figure 4-8: Sector Selection for Surface Parameter Analysis
BNSF San Bernardino Rail Yard
San Bernardino, CA



ENVIRON

Figure 4-9: Locations of Buildings and Structures at the Facility
BNSF San Bernardino Rail Yard
San Bernardino, California

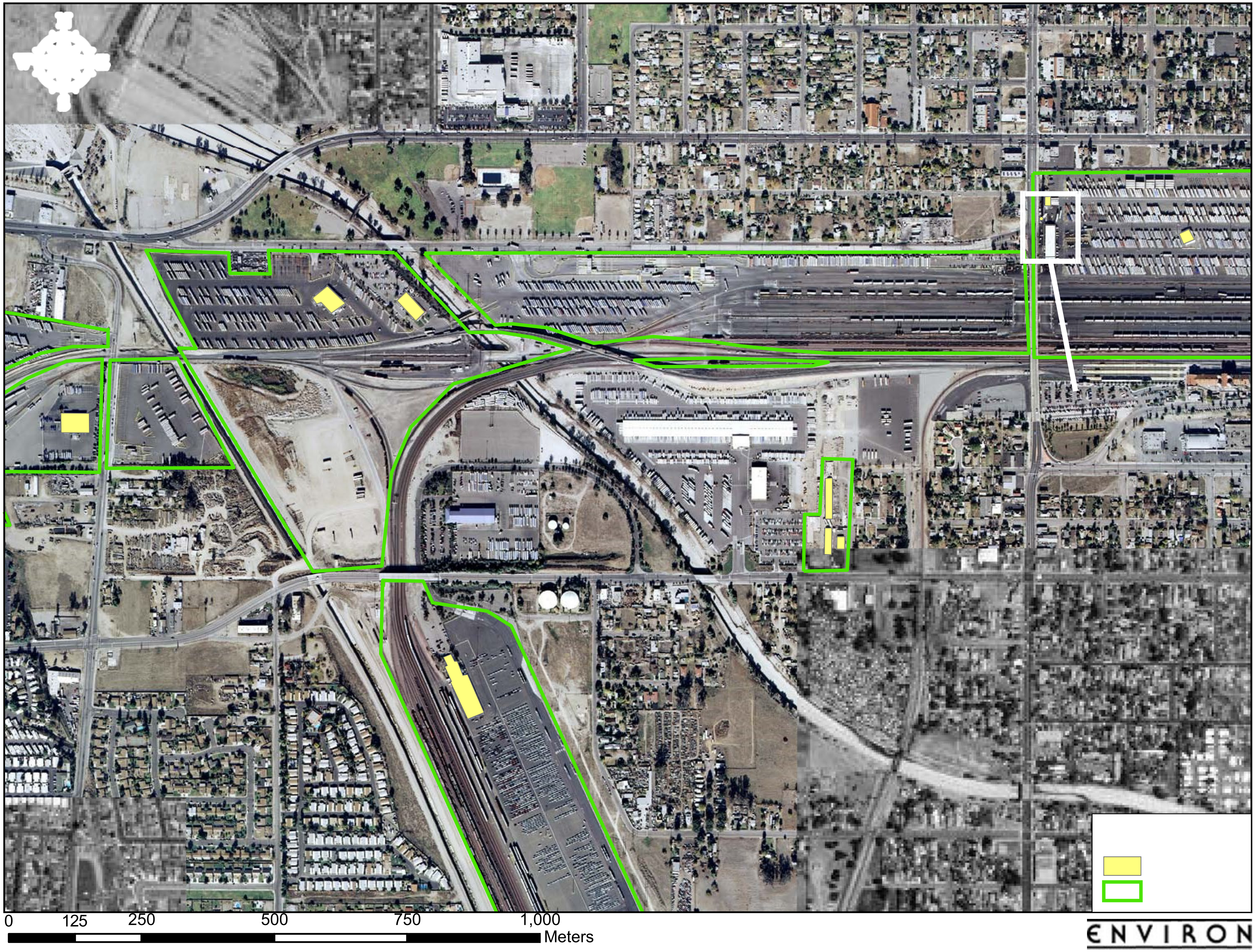


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Figure 4-10a: Land Use Within Three Kilometers of Facility
BNSF San Bernardino
San Bernardino, California

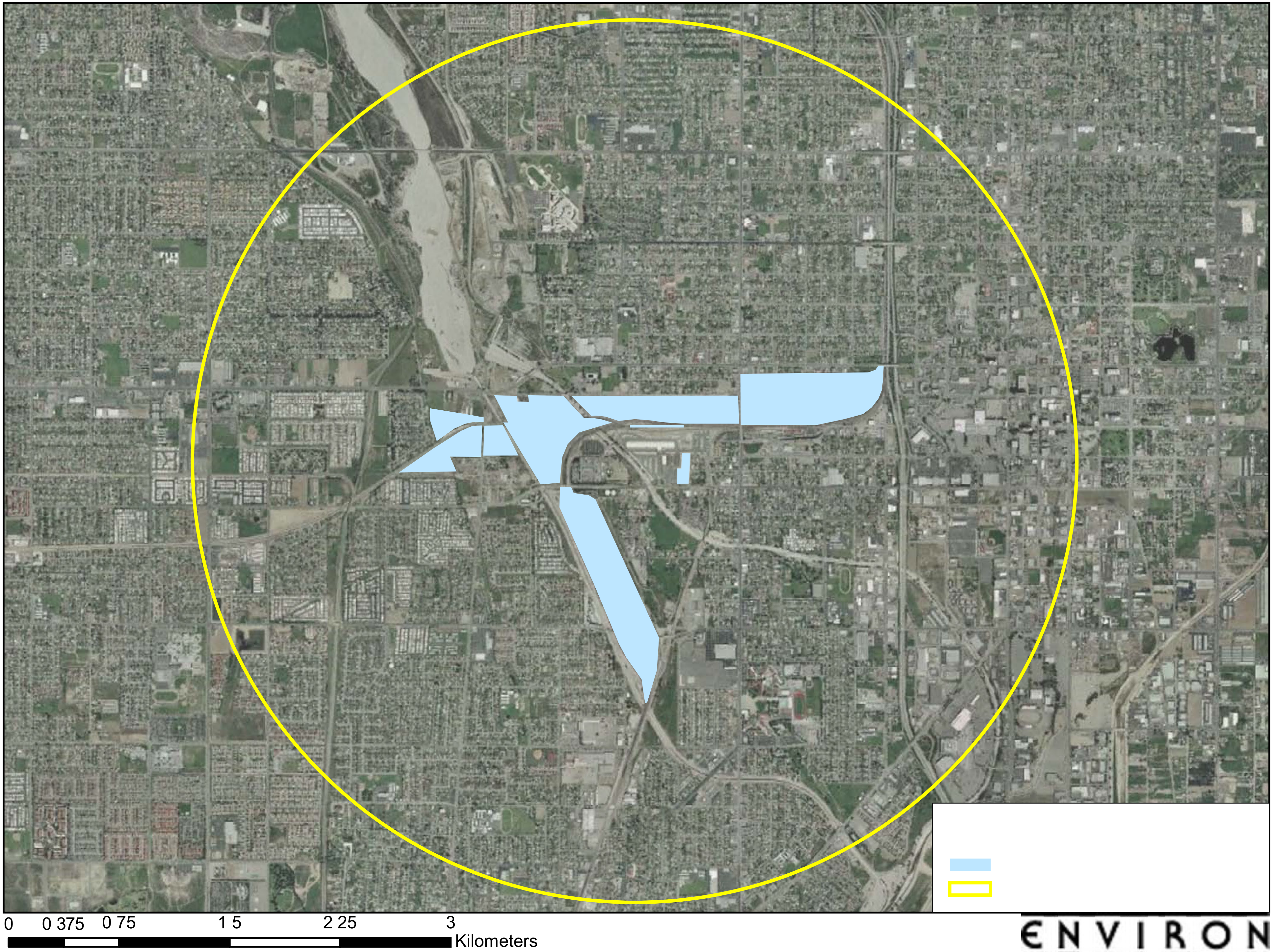

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Figure 4-10b: Population Density Within Three Kilometers of Facility
BNSF San Bernardino
San Bernardino, California

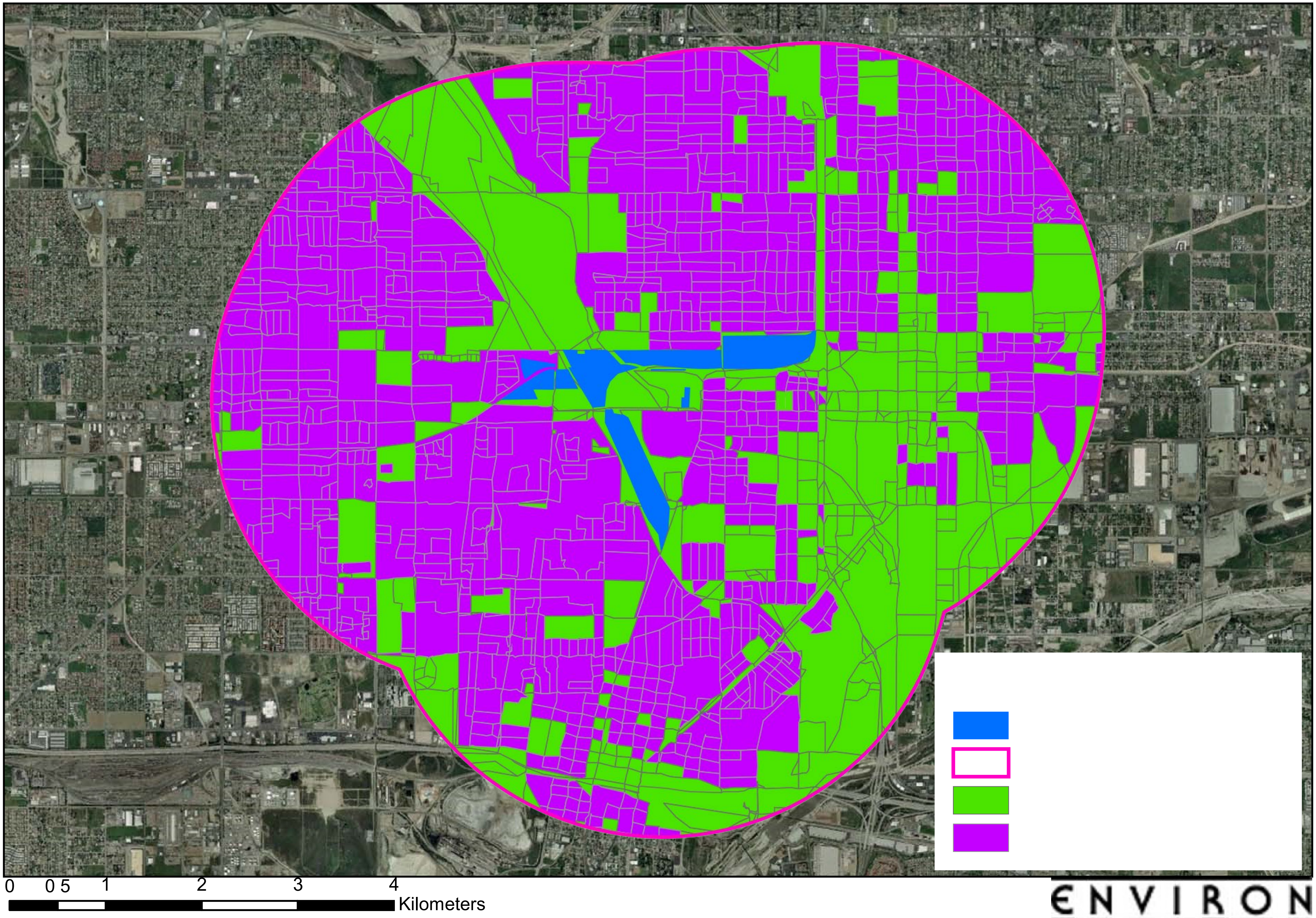

Figure 4-11a: Locations of Discrete Receptors in Coarse Grid
BNSF San Bernardino Rail Yard
San Bernardino, California

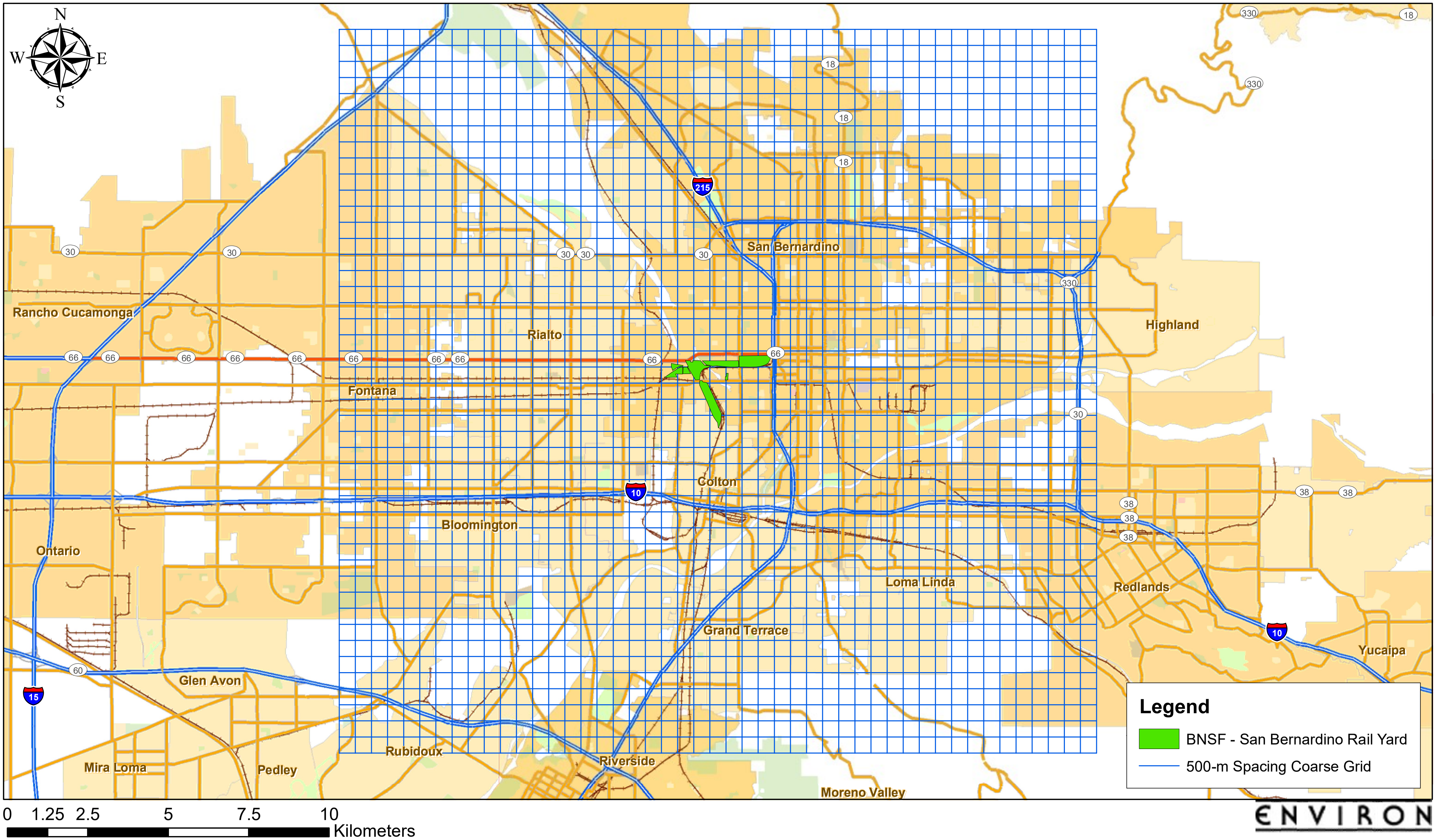

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Figure 4-11b: Locations of Discrete Receptors in Medium Grid
BNSF San Bernardino Rail Yard
San Bernardino, California

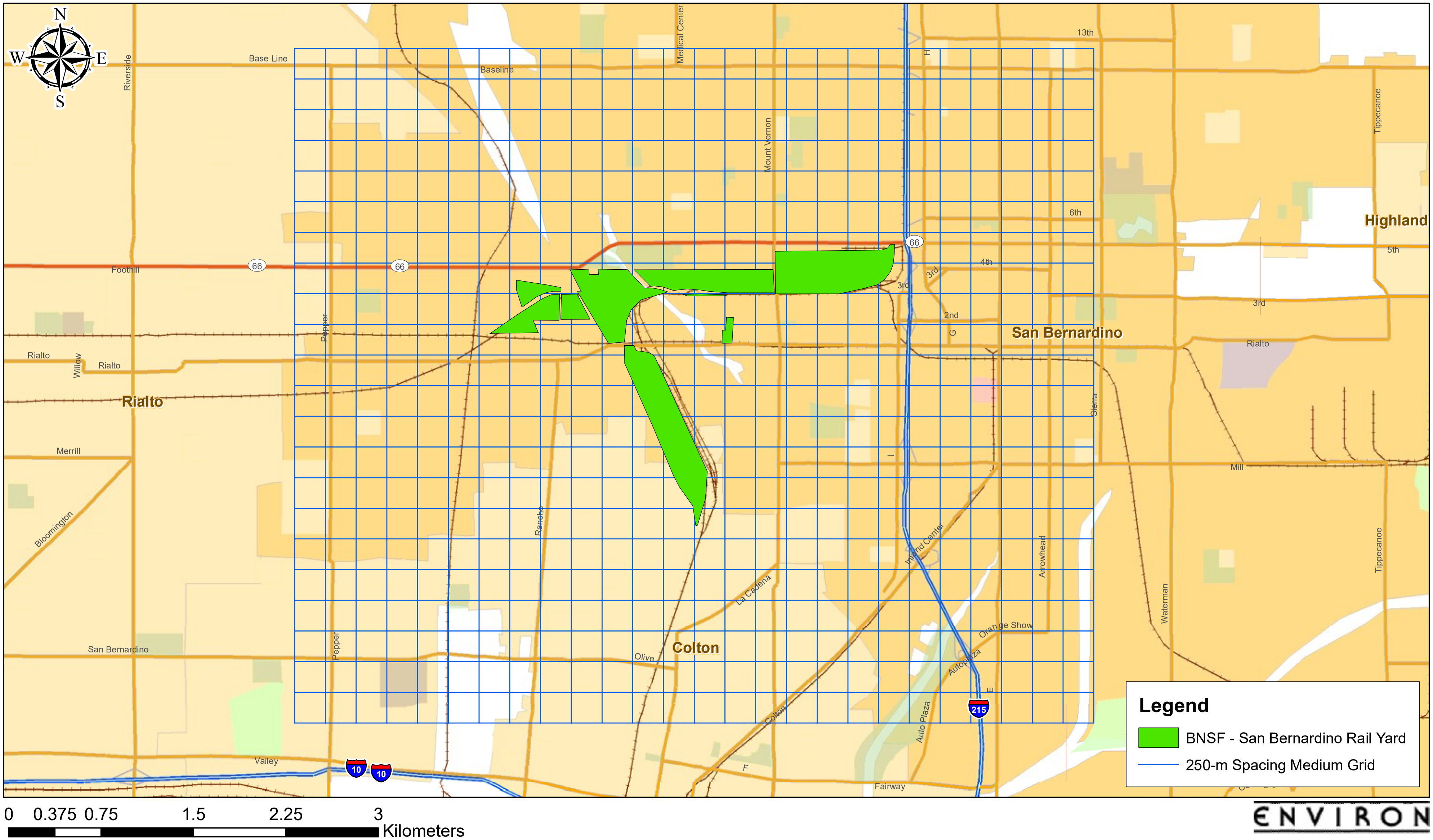

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Figure 4-11c: Locations of Discrete Receptors in Fine Grid
BNSF San Bernardino Rail Yard
San Bernardino, California